IEEE P802.11
Wireless LANs

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| FCC 13-49 Comment Survey |
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Abstract

FCC 13-49 Comment Survey organized in the same framework as 802.11-13/444 comments.

**FCC Comment Summary: 5 GHz Rulemaking, FCC Docket No 13-49**

**Version 4**

**List of Commenters**

This comment summary reflects those names that appear in **bold**. The others will be added later - much of what the “un-summarized” comments have to say is relatively incremental to what is in the comment summary now. What’s reflected here will give you a good sense of the scope of the record. The comment summary is organized to align to the IEEE 802 comments as an organizational matter. As a result, you will see some repetition (e.g., some commenters suggested adopting Rule X as part of the TDWR clean up module, while others suggested that Rule X be associated with the “immediate rule changes” module). The repetition is intentional – so that you don’t miss arguments.

**Advanced Designs (radar mftr)**

**Assoc. for the Advancement of Medical Instrumentation (AAMI)**

**Alliance of Automobile Manufacturers and the Assoc. of Global Automakers (AAM-GA)**

**American Association of State Highway and Transportation Officials (AASHTO)**

**American Radio Relay League (ARRL)**

**Baron Services (broadcast TV weather radar mftr)**

**BNetzA (Germany’s spectrum regulator)**

**Cablevision**

**California DOT**

**Cambium Networks**

**Consumer Electronics Association (CEA)**

**Cisco Systems**

**Colorado Dept. of Transportation (Colorado DOT)**

**Comcast**

**Delphi Automotive**

Engine Advocacy

**Ericsson**

**European Automobile Manufacturers Assoc. (ACEA)**

**European Space Agency (ESA)**

**Fastback Networks**

**First Step (an ISP)**

**Ford Motor**

**General Motors (GM)**

**Globalstar**

**Google and Microsoft (GOOG/MSFT)**

**Hubbard Broadcasting**

**IEEE 802 [31 + Appendices]**

Information Technology and Industry Council (ITIC)

ITS America (ITSA) (identical to Savari)

**ITSPAC**

**Mercedes-Benz**

**Mobile Futures**

**Motorola Mobility**

Motorola Solutions

**National Cable Television Assoc.**

**National Transportation Safety Board (NTSB)**

**OmniAir Consortium**

**Qualcomm**

Ruckus

**SAE International (Society of Automotive Engineers)**

**Savari**

**SES and Intelsat (SES/Intelsat)**

**Shared Spectrum Company**

**Spectrum Bridge**

SPITwSPOTS (ISP)

**Telecommunications Industry Association (TIA)**

**Time Warner Cable**

**Toyota**

Volkswagon

**Utah Dept. of Transportation (Utah DOT)**

**Wi-Fi Alliance (WFA)**

WISPA

1. **Need for U-NII spectrum at 5 GHz**

Thanks for opening a proceeding that asks an expansive set of questions about 5 GHz U-NII operations. (IEEE 802 at 2, 7) (WFA at ii)(TIA at 1) Wider range of proposals made by the Commission will advance the provision of broadband for years to come. (Cisco at 1) Key opportunity to advance Commission’s broadband goals (Cablevision at 1)

Industry cannot meet the expanding demand for Wi-Fi by itself – FCC has an important role to play. (Cisco at 6) Not just more bandwidth (although more spectrum is indispensible) but improved rules.

Time for a reassessment of the existing rules based on outdated assumptions of operating characteristics. (Cisco at 6) Unique opportunity to fine-tune existing rules and evaluate much needed additional spectrum (TIA at 2). Opening new bands will encourage innovation, technology development, and investment (Ericsson at 1)

Commission leadership will be critical to the successful and prompt completion of this docket. (TIA at 2)Pro-active Commission direction will be necessary to assure that the studies are properly designed to yield data that informs the Commission’s decision-making process, that all stakeholders have a role in the process, and that the studies are conducted as promptly as possible. Such Commission leadership will help assure the appropriate balance between protecting incumbent users of the band and establishing a robust market for unlicensed use of the band, particularly as the Commission focuses on the thorny issues associated with designation of the 5350-5470 MHz and 5850-5925 MHz bands for U-NII use. (TIA at 3)

Freeing up spectrum for unlicensed will drive economic growth measured in billions of dollars and increase availability and bandwidth of broadband connections. Allocations at 5 GHz offer particular utility for short range high capacity connections. (GOOG/MSFT at 1, 2, noting importance of TV white spaces and 2.4 GHz) Unlicensed spurs innovation –lesser financial burdens and fewer regulatory restrictions than licensed.(GOOG/MSFT at 2) Balanced of licensed and unlicensed is good. (GOOG/MSFT at 2-3) (CEA at 1 – 5 GHz spectrum will foster fundamental investment and innovation that strengthens the US economy)

Notes support for “most” of proposals (except U-NII-1). (Globalstar at 3, and urges rulemaking action on its 2.4 GHz petition)

Refers to 5 GHz band as “underutilized” and supports Congress and FCC’s examination of whether greater use can be made of it for unlicensed. CEA at 2.

* 1. **Demand drivers**

Agrees with Notice that rising demand for U-NII warrants a review of 5 GHz. (IEEE 802 at 2). Technology used by consumers, business, service providers. (IEEE 802 at 2, 7) (WFA at ii) Wi-Fi is “one of the most important broadband access technologies” (IEEE 802 at 8). Demand is “explosive” (IEEE 802 at 9) Wi-Fi “one of great American success stories” – spurring innovation, job creating, economic growth, new opportunities to businesses and consumers (Cisco at 1-2) Agreeing that popularity of Wi-Fi is creating congestion issues on its own. (TIA at 5)

Wi-Fi is critical to addressing the great infrastructure challenge of the 21st century – broadband. US IP traffic will more than triple from 2011-2016, a compound annual growth rate of 21%. (Cisco at 7). Concurrent with this dramatic growth is the increase in the proportion of traffic originating or terminating on Wi-Fi connectivity. By 2016, Wi-Fi will be delivering approximately the same volume of data as wired connections. (Cisco at 8) Demand for wireless data is increasing exponentially (TIA at 4) See also Cablevision at 1.

Wi-Fi is on pace to soon become the most prevalent vehicle for Internet connectivity in the US and around the globe. Driven by proliferation of Wi-Fi enabled devices. And next – the Internet of Everything, where billions of devices will be connected with many dependent on wireless connectivity. (Cisco at 2) As of December 2012, 174 million of the 326 million connections to US mobile networks consisted of smartphones, laptops, tablets or modems – driving data consumption. (TIA at 4)

Wi-Fi devices have become ubiquitous. While it took more than a decade for the cumulative total of Wi-Fi enabled device shipments to reach 5 billion in 2012, it is anticipated that figure will double by 2015, and more than triple by 2017. (Cisco at 9) Wi-Fi embedded into nearly every smartphone, tablet and laptop, and will be embedded into an increasing number of products that will connect to the Internet (IEEE 802 at 8) Wide variety of devices includes wireless handsets, notebook and netbook computers, tablets, portable electronic games, media players, e-readers, televisions, and cameras. (WFA at 3) (Cisco at 10) Wi-Fi will be in automobiles. (Cisco at 10)

WFA certified 25 percent more products during 2012 than 2011. By 2016, devices in automotive applications will grow 109%, in health/fitness/medical by 39%, and in smart meters/automation by 25 percent. And this is the tip of the iceberg. (Cisco at 10-11) Wi-Fi Alliance is the industry interoperability forum. Last year, certified 3,600 new products. (WFA at 1-2) Consumer demand for Wi-Fi is skyrocketing, with double digit growth in 2011. (NCTA at 7) (CEA at 6-7 stating its US sales records found 165 million Wi-Fi enabled devices were sold in 2012, and predict that 271 million will be sold in 2016.)

Wi-Fi is reaching new sectors – health and fitness, automotive, smart energy. Wi-Fi use in automobiles on the rise for connected navigation, vehicle analytics and safety features, Internet-based radio and general Internet connectivity. (WFA at 4) Medical uses include vital sign monitoring. (WFA at 3-4)

Health care is a demand driver (AAMI at iii, 2-3 & noting its support for this proceeding, 6-8) While dedicated spectrum for health applications should be considered, AAMI is a strong supporter of technologies like 802.11 (AAMI at iii – noting that for dedicated spectrum, there may not always bet the focus, investment and resulting innovations) (AAMI pleading cites extensively from WFA website on growth in Wi-Fi at 3) Agrees that there is a “pressing need” to allocate additional unlicensed spectrum, and states there is also a concern to support access to spectrum for “critical interference-sensitive applications for healthcare.” Allieviating congestion and interference from unmanaged sources is key. (AAMI at 4)

Healthcare providers are increasingly using wireless monitoring from “exclusively high acuity patients to the full range of patient health” to better manage staff resources and improve patient outcomes. Future applications will require more bandwidth – more data, with lower latency, and two-way interactive applications. (AAMI at 6)

Wi-Fi hotspots have proliferated in public spaces, including restaurants, convention centers, parks and airplanes (WFA at 3) (Cisco at 16) In aftermath of Boston Marathon bombing, City of Boston asked Comcast to open Comcast’s hotspot network for unrestricted access so that the public could communicate even as mobile networks became congested. Comcast’s actions were credited by the City with helping to preserve order in the aftermath of the bombing. (Cisco at 16-17) (See also Time Warner Cable at 1-2, 6 commenting on role its Wi-Fi networks played in Superstorm Sandy) (See also Cablevision at 3 – 40% of hotspots stayed up during Sandy and 90% operational within one week)

Cable industry has invested heavily in expansive Wi-Fi networks. Allow cable subscribers’ access to fast and reliable Internet when away from their homes and offices, advancing the FCC’s broadband goals. (NCTA at 1) Cable operators have deployed 150,000 Wi-Fi access points throughout the country and more are coming. (NCTA at 3) These “metronets” deploy thousands of hotspots in a metro area to provide substantial coverage. These benefit consumers by providing broadband access, mobile offloading and alleviate the licensed spectrum crunch. (NCTA at 4) Cablevision has deployed 80,000, Comcast has deployed 50,000 and Time Warner Cable has deployed 15,000 with plans to double that number in 2013. Bright House (16,000) and Cox (1,400) are contributing also. (NCTA at 5) Five of the firms offer subscribers reciprocal rights under the CableWiFi brand. (NCTA at 5-6)

Wi-Fi plays a key role in allowing cable to deliver connectivity anywhere, anytime on any device (Time Warner Cable at 4) Notes that its access point system is open to the public for a fee. (Time Warner Cable at 4) Time Warner’s largest deployment is Los Angeles, where it has spent $15 million deploying hotspots throughout the city. (Time Warner at 5)

Time Warner Cable - In December 2012, the number of unique users accessing TWC’s Wi-Fi network grew by over 720 percent, and data consumption per user grew by over 100 percent, compared to December 2011. In addition, the devices per user increased by 11 percent, and the average minutes per session increased by 81 percent. TWC’s experience confirms that the strong consumer demand for ubiquitous Wi-Fi coverage will only continue to grow. (Time Warner Cable at 6)

With targeted rule changes, the Commission could unleash the 5 GHz band for outdoor2 WiFi, spurring investment, innovation and job creation, in addition to dramatically expanding the ability of consumers to access the Internet and other data services. Combined with targeted agreements for additional coverage, such a service could eventually compete directly with traditional CMRS service. (Cablevision at 1) Cablevision announced a plan to invest $300 million dollars to develop a WiFi network across its footprint. Today, Optimum WiFi is the largest contiguous WiFi network in North America. Service is offered free to Cablevision’s broadband customers. It has 80,000 hotspots in New York, New Jersey and Connecticut and has been used by over 1 million customers. Optimum WiFi has served more than one billion customer logons and transported more than 17 petabyte s― 17 quadrillion bytes ― of broadband data. Use of the network has been increasing dramatically as consumers are setting their smartphones and tablets to  connect  to  Cablevision’s  WiFi  network  instead  of  their  wireless  carrier’s  cellular  network, and as they turn to WiFi-only devices without need for cellular service at all. Use of the Optimum network is a cost savings for consumers who do not need to use their mobile carrier as much and who can switch to a lower tier of mobile service. Service is growing fast – added 40,000 hotspots last year. Speeds have been increased to 15 Mbps down and 4 Mbps up. – faster than most 3G and 4G networks. Cablevision also participates in Cable WiFi, so that customers can use other cable MSO hotspots. (Cablevision at 2-3)

From cable’s perspective, because it only uses U-NII-3 today, opening new spectrum will triple the amount of usable spectrum. (NCTA at 12)

WISPS claim to have served 3m people, primarily in rural areas. Some of those customers would not have broadband but for WISPs. (WISPA at 3)

Wi-Fi devices are principle users of band and “critical drivers” to US economy. (WFA at 1) Contribute between $50 and $100 billion per year. (NCTA at 3)

Wi-Fi improves the value of fixed broadband because it makes broadband more ubiquitous (WFA at 3)

Need contiguous spectrum to meet the challenge of evolving uses – in particular, transmission of multiple video streams. (WFA at 1)

Public will benefit from FCC rule modifications at 5 GHz. (WFA at 1) Agrees that needs of businesses and consumers for fixed and mobile broadband require FCC to explore fully ways to reduce significantly the potential for interference to authorized users of 5 GHz. (TIA at 3-4)

Role in mobile offloading - Quoting former FCC Chairman Julius Genachowski, Wi-Fi is an essential part of the mobile ecosystem and overall economy. It complements licensed spectrum and bridges the supply/demand gap for mobile. (WFA at 2) (Cisco at 11-12) (CEA at 4-5) Agrees with Notice that Wi-Fi improves the mobile experience in that many users prefer Wi-Fi connectivity to mobile and providers recommend users take advantage of Wi-Fi to keep data transmission costs down. (WFA at 3-4) Explains its “real-time steering” technology that dynamically switches users between cellular and carrier Wi-Fi networks. (Ericsson at 2)

Benefits of offloading help manage licensed spectrum crunch. US mobile data traffic carried over licensed networks will grow 9-fold from 2012-2017, from 0.2 Exabytes per month to 1.9 Exabytes per month, a CAGR of 56%. (Cisco at 12) But that traffic is a drop in the bucket compared to all the traffic those mobile-enable devices will generate – by 2017, the devices will be generating 5.7 Exabytes per month and all of the traffic not carried by mobile networks will be carried by Wi-Fi. (Cisco at 13-14). By 2017, 66% of mobile device generated traffic will be offloaded. (Cisco at 14) (TIA at 4) (CEA at 1, 2, 8, noting 3 of top 4 mobile carriers offloaded 50% of traffic by early 2012). Mobile data offloading doubled in 2012 relative to 2011. (Cisco at 15) AT&T announced that the amount of mobile device traffic exchanged on its Wi-Fi network during 2012 was three times larger than in 2011. (Cisco at 15) And this is still early days, as AT&T plans to expand its Wi-Fi deployment (Cisco at 15-16). (TIA at 4,6 – demand for mobile data cannot be satisfied with licensed spectrum alone) (NCTA at 8 – Wi-Fi accounts for an estimated 80% of all traffic from consumer devices) See also Cablevision at 1 (Wi-Fi helps manage exploding data usage threatening to overwhelm traditional mobile networks) (See also general support from Mobile Future for opening 5 GHz band to U-NII)

Offloading has become more important due to the adoption of the Wi-Fi Certified Passpoint Program, which makes Wi-Fi access as easy and secure as accessing a cellular network. As a result of Passpoint, there is no need for subscriber log-in, and security requirements work well with mobile networks. (Cisco at 16)

Wi-Fi is an integral factor in Administration’s goal and FCC’s goal to deploy seamless broadband. Wi-Fi costs much less to deploy than large service provider networks and therefore complement those networks. (WFA at 4-5)

Significant economic engine. One in six people globally use Wi-Fi. Last year, Wi-Fi carried 69 percent of total traffic generated by smartphones and tablets and was responsible for 57 percent of total traffic from PCs and laptops. This level of connectivity has resulted in a total economic gain for all households of around $52-$99 billion annually. (WFA at 5) (*See also* GOOG/MSFT at 1-2)

Unlicensed spectrum also promotes innovation by lowering the barriers to entry for service providers, application developers, and manufacturers. (CEA at 5). Unlicensed spectrum also grows the US economy- quoting Acting FCC Chairwoman Clyburn that unlicensed generates between $16 and $37 billion annually. (Thanki study) Notes adoption of Wi-Fi has been unusually fast – first Wi-Fi lap tops in 1999, and by 2011, 61% of US households had Wi-Fi networks. (CEA at 6).

US submission to Working Party 5A in conjunction with WRC-15 prep recognized that spectrum requirement for broadband RLANs in the 5 GHz frequency range in 2018 is estimated to be 880 MHz. (Cisco at 6 and footnote 14)

The 2.4 GHz band has “become saturated during certain times of the day in heavily trafficked areas.” (GOOG/MSFT at 3, citing an earlier NCTA filing in GN Docket 12-354) (NCTA at 1) Imposes large costs on consumers because Wi-Fi is the most heavily used form of wireless broadband connectivity. (GOOG/MSFT at 3) Timely action in this docket is important. (GOOG/MSFT at 4)

Recent study suggests 2.4 GHz band is exhausted by end of 2014. (NCTA at 8-9 and Attachment) (See also Cablevision at 3) From 2011 to 2015, Wi-Fi traffic will grow 250%, but growth in hotspots and increases in efficiency will not be enough to meet this demand without additional spectrum. (Cablevision at 3-4)

Notes Bluetooth, Zigbee, Z-Wave, NFC and wireless HD also use unlicensed spectrum and that shipments of these devices will top 5 billion in 2013 and reach 8 billion in 2018. (CEA at 7-8)

* 1. **Technology drivers**

Strong focus on whether a contiguous band can be made available. 802.11ac uses bands 80 or 160 MHz wide. Having access of up to nine 80-megahertz wide channels or four 160-megahertz channels is key to meet foreseeable demands on technology (IEEE 802 at 2,) (WFA at ii, 6) (TIA at 5) NPRM’s goal of making the entire 5150-5925 MHz available for unlicensed U-NII operations so that Wi-Fi devices can operate across different U-NII bands is key. (WFA at 6) (Qualcomm at Summary – noting importance of DSRC also) (NCTA at 9)

5 GHz is ideal expansion band as 2.4 GHz exhausts. Standards are in place. Manufacturers already build devices in the band. Much of the band is globally harmonized, and Europe is considering expanding the 5 GHz footprint, as well. 5 GHz also provides a substantial amount of spectrum for unlicensed use. Today, cable can only really use U-NII-3 for its deployments (NCTA at 8-10) (Cablevision at 1) (Time Warner Cable at 2, 7, noting that .11ac is designed specifically for the 5 GHz band) Time Warner also notes uncertainties remain with respect to 600 MHz spectrum and 3.5 GHz spectrum (Time Warner Cable at 8)

By making available the large swath of contiguous spectrum that can be provided for U- NII at 5 GHz, the Commission can facilitate the provisioning of the multi-gigabit throughput that is needed to support advanced applications, as well as optimizing a more efficient channel arrangement. (TIA at 5) (CEA at 1, 2-3)

New generation of Wi-Fi is much improved. The 802.11ac standard has a link data rate of approximately 1 Gbit/s, compared to 54 Mbit/s for the 802.11a standard and 54 Mbit/s to 600 Mbit/s for the 802.11n standard. Together with other technology improvements, supports a better experience for each client and more available bandwidth for a higher number of parallel video streams. (WFA at 5-6) (Cisco at 17 – throughput chart for various formulations of 802.11ac) (TIA at 5-6, discussing more generically “unlicensed technology” of which 802.11ac is an example) (GOOG/MSFT at 4) NCTA wants to make the new “gigabit Wi-Fi” technology available to businesses and consumer as soon as the new standard is finalized. (NCTA at 11) See also Cablevision at 3-4.

Per 802.11, three key technology advances in .11 ac:

Unlike 802.11n, which is limited to a maximum channel bandwidth of 40 MHz, 802.11ac permits channel bandwidths of 80 MHz and 160 MHz, which increase speeds by 117 percent and 333 percent, respectively;

2.11ac employs higher-density modulation, accommodating up to 256 quadrature amplitude modulation (QAM), as opposed to the maximum 64 QAM permitted under 802.11n (for a 33 percent speed burst at shorter, yet still usable, ranges); and whereas 802.11n allowed up to four simultaneous spatial data streams, 802.11ac provides for up to eight (for another 100 percent increase in speed) (Cisco at 18)

Presents 5 GHz 802.11ac channel plan based on access to existing spectrum (five 80-megahertz channels and one 160-megahertz channel) versus if the FCC plan can move forward (nine 80-megahertz channels and four 160-megahertz channels). Represents an “enormous gain” in ability to meet consumer demand.(IEEE 802 at 11) (Cisco at 20 – chart with proposed new channels)

Contiguous block allows “maximum efficiency.” (WFA at ii) Shorter transmission times better utilize spectrum, and have lower batter consumption. (NCTA at 11) Applications for HD video are important. (NCTA at 12)

Proposals in docket will help advance “gigabit Wi-Fi” under .11 ac standard. (NCTA at 1, 11)

On a technology neutral basis, FCC should strive to provide U-NII devices access to the broadest possible swath of contiguous spectrum under harmonized rules that will accommodate the evolution towards substantially wider channel bandwidths and the efficiency that results for those wider channel. (TIA at 8)(Ericsson a 5-6) FCC should act to “minimize congestion” as is occurring in 2.4 GHz. (TIA at 8) Important to adopt rules that are technology neutral. (TIA at 8) (NCTA at 7 – 2.4 GHz is nearing exhaustion and 5 GHz is logical expansion band)

IEEE is on track to approve the .11ac standard in February 2014. (Cisco at 20-21) (TIA at 6) WFA will refresh its interoperability testing to include testing of the more advanced features. (Cisco at 21) Vendors are already shipping pre-standard devices. (Cisco at 21) By 2015, nearly one billion .11ac devices will ship (Cisco at 21) 802.11ac is “here today” and number of units shipping will grow even in 2013. (TIA at 6)

The edge of the Internet is evolving, and Wi-Fi must evolve with it. Cisco asked Plum Group to evaluate this trend. Plum concluded that Wi-Fi needs to deliver speeds consistent, on a shared contended basis, with available broadband access speeds (around 100 Mbps by 2020) and capable of meeting for short durations (with low likelihood of contention) high speed device-to-device connectivity needs (1 Gbps or more). Second, Wi-Fi needs to be able to deliver these speeds while meeting demand from multiple simultaneous competing uses. To achieve this, Wi-Fi must be able to access more spectrum in the 5 GHz bands. Additional 5 GHz spectrum could double the capacity of Wi-Fi. (Cisco at 22-23 and Appendix) (*See also* GOOG/MSFT at 3 – 2.4 GHz has become saturated at certain times of day in heavily trafficked areas) (NCTA at 1 – 2.4 GHz band is being overwhelmed by consumer demand)

Agrees that existing 5 GHz bands will not support future consumer demand. (GOOG/MSFT at 4) Agrees adding spectrum and revising rules will provide additional short range capacity. (GOOG/MSFT at 4)

Mentions outdoor use as a particular benefit and names the outdoor networks now being deployed by cable MSOs. (GOOG/MSFT at 4) Has the potential to improve broadband access in rural areas, along with other unlicensed bands in use (2.4 GHz, 900 MHz and potentially the TV white spaces) (GOOG/MSFT at 5)

* 1. **About U-NII operations/regulatory status**

U-NIIs cannot cause interference and must accept all interference from those with superior spectrum rights. FCC and stakeholders must have confidence that U-NIIs will not cause harmful interference. “Harmful interference” is not defined – useful because the term needs to be flexibly applied depending on the situation. Middle Class Tax Relief Act said “primary mission of the Federal spectrum users…will not be compromised” and this is a useful way to think about whether U-NIIs can make improved and expanded use of the band. (IEEE 802 at 9. )

Notice says - “We believe that responsible operation of U-NII devices is a joint responsibility of both manufacturers and users.” IEEE 802 agrees, and would add that it is also a responsibility of the FCC, the NTIA and other federal agencies, including their vendors, to work with industry to make certain that decisions taken on unlicensed device use are made on the best information possible, are thorough, and therefore provide certainty and stability in the spectrum sharing environment for all stakeholders. (IEEE 802 at 9-10)

All spectrum available for U-NII operations in the 5 GHz band today is shared with other unlicensed and with incumbent and/or allocated uses. In order for FCC to further promote U-NII in the 5 GHz band, it must be satisfied that incumbent users are protected. Rules that inadequately protect incumbent operations waste valuable Commission resources and potentially jeopardize existing operations, and in the case of federal operations, could affect federal agency missions that require spectrum resources. (WFA at 8-9) Rules must “protect incumbents” while allowing for more complete use of spectrum by U-NIIs. (WFA at 9) (See also GOOG/MSFT at 1-2) (See also Cambium at 5) (CEA at 2, 11-12)

Throughout the 5 GHz band, the Commission should seek to foster coexistence of incumbent systems and unlicensed technologies, while at the same time minimizing the potential for congestion among U-NII users. (TIA at 3) Commission should provide appropriate levels of interference protection to federal and other incumbents in the 5 GHz band. (TIA at 7-8)

The Commission’s leadership will be important both in creating a balance between  protecting incumbent users of the band and creating a robust market for unlicensed use of the  band and in assuring that unlicensed users can coexist amongst themselves in the band. (Ericsson at 3)

Harmonization should be viewed as part of a process that leads to more efficient spectrum utilization to enable faster and more reliable broadband delivery. Where there are already disparate rules and vibrant ecosystems in multiple sub-bands, complete harmonization of the rules across all of the sub-bands is not possible without disrupting existing operations, a result the Commission obviously should want to avoid. (WISPA at 10)

1. **Sequencing of FCC decision-making**

Identify and group issues into modules that can be resolved quickly. Group those that need more time separately. (IEEE 802 at 3, 12) (Cisco at 24) (TIA at 2-3, 8-9) (NCTA at 13) (Time Warner at 3) Series of partial decisions allows benefits to flow immediately to consumers and business users. (IEEE 802 at 12) (Cisco at 24) (TIA at 8 – timely action is “essential”) (Ericsson at 4) Public interest best served if the FCC can adopt decisions for which the record is well developed and/or for which there is general agreement among commenters. (WFA at 7) (Cisco at 24)

In the words of the D.C. Circuit (paraphrasing Voltaire), “[t]he best must not become the enemy of the good, as it does when the FCC delays making any determination while pursuing the perfect [outcome].” (TIA at 8-9)

With modular approach, could begin issuing decisions in 1st calendar quarter of 2014, if not sooner. (IEEE 802 at 13) (WFA at 7) (Cisco at 25 – resolve TDWR and “immediate” rule changes as early as 4th quarter of 2013) NTIA has set out aggressive milestones for its work – FCC should do likewise. (TIA at 8) (TIA at 11 – asking that TDWR and several noncontroversial rule changes be adopted by the end of the 2013 calendar year). NCTA requests fast action, before 802.11ac standard is finalized next year (NCTA at 3)

**Groupings:**

**U-NII-2C/3** - resolve issues in **a TDWR module** (IEEE 802 at 3)(WFA at ii-iii) (Cisco at 25) (TIA at 9-10)These directly address TDWR interference issues seen to date. (WFA at ii-iii, 7).

* TDWR issues: improved security, extend revised 15.407 to U-NII-3, limit user ability to configure domain so DFS cannot be turned off (IEEE 802 at 3, 12) Adopt revised Bin 1 (WFA at ii) Expand U-NII-3 by 25 MHz to 5850 MHz. (WFA at ii, 8) Significant record exists already and significant benefits if issues can be resolved, e.g., elimination of 50 megahertz wide notch. (IEEE 802 at 12) (WFA at ii-iii, 7-8)(TIA at 9 – example is the Bin 1 waveform, around which there is consensus) (*But see* TIA at 11, suggesting that the application of a harmonized 15.407 to 5725-5850 MHz may take longer than the “immediate” rule changes discussed by other commenters)

**Immediate rule changes module** consists of: (IEEE 802 at 12) (WFA at 8) (Cisco at 25)

* Codify guidance to forbid devices that allow users to turn off DFS (IEEE 802 at 3)
* Require DFS to be “on” when devices are on (IEEE 802 at 3)
* Introduce spectral density requirement if devices are certifying under the relaxed -62 dBm standard for co-channel sensing (IEEE 802 at 3)
* Revise Bin 1 (IEEE 802 at 3)
* Eliminate uniform channel spreading (IEEE 802 at 4)
* Revised channel loading test (IEEE 802 at 4)
* Miscellaneous rules from para. 113 (IEEE 802 at 4)
* Transition from old rules to new (IEEE 802 at 4)
* Add 25 MHz U-NII rules from 5825 MHz to 5850 MHz

**Other rule changes module**: (IEEE 802 at 12)

* Examine possible low power exemption to DFS (IEEE at 4)
* **U-NII-1 harmonized** to U-NII-2A and eliminate indoor only requirement(IEEE at 4) (WFA at iii, 8 – resolve this at same time a “immediate” rule changes above) (Cisco at 25) (TIA at 10-11) NCTA wants the U-NII-1 band “moved expeditiously” (NCTA at 16)

**U-NII-4 module** (IEEE at 4,12) (WFA at iii, 8)(Cisco at 25) (TIA at 8 – provide a “clear path forward” to designate this spectrum for U-NIIs; TIA at 12-13 – these issues likely to take longer to solve) NCTA wants U-NII-4 opened expeditiously. (NCTA at 25-26)

**U-NII-2B module** (IEEE at 4,12) (WFA at iii, 8)(Cisco at 25) (TIA at 8 – provide a “clear path forward” to designate this spectrum for U-NIIs; TIA at 12-13 – these issues likely to take longer to solve)

1. **U-NII 2A, 2C, 3 – changes to protect TDWR**

Notes “bumps in the road” with respect to TDWR and U-NII, but states that all cases so far have involved frame-based equipment, not 802.11 U-NIIs. (IEEE 802 at 10))

Key – that there is no case to date where functioning DFS has not detected radar. DFS works. (IEEE 802 at 10) Devices were non-compliant or were modified to be non-compliant by users. (IEEE 802 at 13) (WFA at 10-11)

Record is well developed. FCC is well situated to resolve these issues. Helps U-NII manufacturers by eliminating uncertainty. (Cisco at 26) (TIA at 8-9) Cases to date demonstrate a relatively small number of fundamental issues with respect to outdoor deployments: (1) Bin 1 did not reflect actual TDWR modes of operation (2) U-NII-3 devices were being illegally modified for use in U-NII-2A and 2C (3) devices certified for use in U-NII-2C were being illegally modified to operate without DFS or to employ technical parameters outside of the rules and (4) devices certified under 15.247 of the rules operated at power levels not permitted under 15.407. (Cisco at 26-27)

By adopting the comprehensive package of rule changes and measurement procedures below, the FCC can quickly address the TDWR issues, and do so in a way that has minimal impact on the viability of 5 GHz to meet growing demand for Wi-Fi. While this package of proposals should be accepted, proposals in the Notice for more burdensome restrictions on U-NII devices must be rejected. These more burdensome restrictions aim to fix what is not broken. (Cisco at 27-28)

Package of proposals listed in Notice would specifically address TDWR concerns and should be adopted:

Uniform application of 15.407 to U-NII-2C and U-NII-3; improved security requirements, prevent user configuration of devices post-manufacture (IEEE 802 at 14; WFA at 9) Recommend retaining the general test procedures in KDB 789033 for measuring the emissions compliance of U-NII devices for Section 15.407 (IEEE 802 at 14) Revised Bin 1 (WFA at 9)(see further discussion below)

Cambium accepts that TDWR installations must be protected from interference, and we consider that manufacturers, regulators, distributers, installers and operators all share a responsibility to ensure that unlicensed wireless devices do not cause interference to TDWRs. (Cambium at 1)

Cambium supports database registration for devices operating close to TDWRs with the devices consulting a database at some specified frequency, or at restart, for permission to continuously operate. (Cambium at 2)

But see Baron Comments (summarized here in the section on U-NII-2B) commenting on the changes to DFS that would be needed to protect broadcast weather radar. Baron favors every rule that is more restrictive and more protective of TDWR.

* 1. **Application of unified Section 15.407 to U-NII-2C and U-NII-3 (Notice at paras. 26-28)**

Supports harmonization of 2A and 3 under one rule. (IEEE 802 at 17) This rule addresses one of the prime causes of interference to TDWR- high gain antennas. (IEEE 802 at 17) (TIA at 3 – generally supporting harmonization to the maximum extent possible) (Ericsson at 6, but noting that it does not think DFS should be required in all bands)

Supports removal of 15.247 as a certification option for devices in the 5725-5850 MHz band. (IEEE 802 at 17) (See generally CEA at 3 – harmonize where feasible; CEA at 12-13 – harmonization helps manufacturers scale & reduce equipment cost, speeds certification & therefore speeds innovation to market, supports 802.11ac)

Supports application of 15.407 instead of 15.247 under the proposal, except the antenna gain rule. (Fastback at 3)

Supports adding 25 megahertz to U-NII rules so that U-NII band extends from 5825 MHz to 5850 MHz. (IEEE 802 at 17)(WFA at 11-12)(TIA at 11) (also see discussion below) (Ericsson at 4) (NCTA at 17)

Harmonizing the rule and adding the 25 megahertz removes an incentive to choose 15.247 certification, which allows higher power spectral density levels. (WFA at 10) Rule disparity introduces complexity in the equipment authorization process and creates a hazard for incumbents in U-NII-2C. (WFA at 10) Proposed rules allow access to more bandwidth while limiting the possibility of harmful interference to government operations. (WFA at 11)

Supports the following FCC rule change proposals for 15.407 relevant to TDWR-

* Remove the Section 15.407 alternative variable power limit by removing the bandwidth dependent term (17 dBm + 10 log B). As a result, the **Section 15.407 power limit would be 1W**. (IEEE 802 at 17) (WFA at 12) (Cisco at 43) But See Cambium at 3-4 (opposing the 15.407 rule because devices will need to incorporate transmitter sections of considerably greater complexity including the use of additional high performance RF filters; increases cost; higher cost devices threaten applications now supported. Notes that the transition band of the additional RF filter would reduce the number of channels available – leading to congestion) Cambium believes TDWRs more at risk from “2C” U-NIIs than those in “3”. Cambium at 4. First Step also objects (First Step at 4 – citing need for long range point to point links for rural broadband)

WISPA also opposes the application of 15.407 rules to the U-NII-3 band. It states there are 19m households without broadband, 14.5m of which are rural and that the FCC and NTIA agree there is a rural disparity – more rural residents do not have broadband connectivity. The 15.247 rules allow WISPS to reach more households economically and should be retained. (WISPA at 3-6, 12-13 – nearly every WISP uses equipment with antenna gains higher than 23 dBi)

* **Apply existing Section 15.247 Power Spectral Density (PSD) rules across U-NII-3**. Above a 20 megahertz emission bandwidth, the 1 Watt power limit becomes the limiting parameter, and the PSD is the same for equipment certificated under either Sections 15.247 and 15.407. Wi-Fi bandwidth is greater than 20 megahertz. (IEEE 802 at 17) (WFA at 12)(Cisco at 44)
	1. **Improved security will guard against unauthorized user modification (Notice at paras. 51-53)**

Supports FCC plan to require improved security for master devices. (IEEE 802 at 14-15, noting that this does not require devices to be certified as SDR) (Ericsson at 6, 8) Specifically addresses enforcement cases to date (IEEE 802 at 15) Significant number of enforcement cases have involved users retuning devices approved for U-NII-3 into U-NII-2C, even though the devices are not equipped with DFS. Had an improved security showing been in force, it would have eliminated most interference cases, based on the record revealed to date. (WFA at 15) (Cisco at 31 – strongly supports) (TIA at 11– should not prove particularly controversial) (NAB at 7 – supports). (NCTA supports at 23) Cambium “welcomes” security measures that prevent user modification. (Cambium at 1-2) (Fastback at 7) (WISPA at 17)

Whether the device is certified for a U-NII band that does not require DFS and is then modified to operate in the U-NII-2A and U-NII-2C bands, or the device is certified to operate in the U-NII-2A and U-NII-2C bands and is modified illegally to disable the DFS mechanism, the end result is the same – an increased threat of interference to TDWR and other radar systems that DFS is intended to protect. (Cisco at 31)

FCC warning that users should not modify radios has not proved to be sufficient. Agree that manufacturers can do more. (IEEE 802 at 15) (Cisco at 31-32, citing KDB 594280) Notes that Section 2.931 of the rules requires the manufacturer of certified RF equipment to ensure that the product as sold continues to comply with the conditions of equipment certification (Cisco at 31).

Favorably cites to KDB 442812 (IEEE 802 at 15, describing security showings required in SDR filings as an example of what could be required; recommends FCC issue further guidance document on the specific showing required) SDR regime has been in place several years; should be confidence that it works well (IEEE 802 at 16) (Cisco at 32, also citing to Section 2.944 requirements for SDRs) Benefits of this rule outweigh costs. (IEEE 802 at 16) Agrees that SDR experience is helpful to resolving this issue and that showings listed in KDB 442812 are a good reference point for what should be required in this case. (WFA at 15-16) (Cisco at 32-33) Notes that a recent consent decree with a U-NII manufacturer included requirements similar to Section 2.944. (Cisco at 33) See also Cambium, suggesting SDR-type rules (Cambium at 2)

Agrees that manufacturers should ensure that reconfiguring firmware or software which affects regulatory compliance, by someone other than the manufacturer or authorized by the manufacturer, is made very difficult. (IEEE 802 at 16) (NAB at 7) Manufacturers should ensure that reconfiguring firmware or software which affects regulatory compliance, by someone other than the manufacturer or authorized by the manufacturer, is made very difficult. (WFA at 14) FCC should allow flexibility in approach, but idea that master devices disable operations if software or firmware is replaced, modified or reconfigured by someone other than the manufacturer “has merit”. This will provide an important additional protection to radar systems. (Cisco at 33-34)(NCTA at 23-24 – rules should focus on outcome, not mandate “how” technology operates) (*But see* Ericsson at 7 – such a solution is “complex” and requires locking/encrypting binary images in those devices.) Cambium states that security should ensure that it should be impossible or practically impossible to modify software supplied by the manufacturer. (Cambium at 2, noting that there will be some development costs, but does not project an increase in manufacturing cost)

Shared Spectrum takes the view that “tamper-proof” security will be unduly costly. (Shared Spectrum at 4-5)

Opposes requirement that U-NIIs transit identifying information so that interference could be located to a device. No technical capability exists. U-NIIs do not use call signs. SSIDs do not have to be broadcast and often don’t include identifying information. Complexities of a geolocational database are best avoided. Improved security (as per above) should be sufficient). (IEEE at 16) Stronger security measures proposed above should be sufficient. (WFA at 16) (Ericsson at 7, noting transmission of a “beacon” signal that can be used to find sources of interference) (*But see* NAB at 7-8 supporting the proposal.)

* 1. **Adopt other rule changes addressing TDWR issues**
		1. **Revised Bin 1 (Notice para. 73)**

Supports. Now includes test patterns that reflect actual TDWRs, which existing Bin 1 does not. While there is no enforcement case illustrating that operating DFS failed to detect TDWR, this is a critical test and must reflect the operational parameters of government systems. (IEEE 802 at 23) (WFA at 9, 17)(Cisco at 28-29) (TIA at 8-9) (WISPA at 18)

 (But see Fastback at 9-10 – “has not completed its analysis”)

Agree that this test should be updated on delegated authority. (IEEE 802 at 23) (WFA at 17, 32) (Cisco at 29)(TIA at 8-9)

* + 1. **More stringent antenna gain (15.407) (Notice – para. 33)**

Supports FCC plan to apply the more stringent rule from 15.407 instead of 15.247. (IEEE 802 at 18) (Ericsson at 5)(TIA at 11 – should not be particularly controversial) Will reduce the range of point to point systems, but problems associated with these high gain systems have been highly disruptive to industry. Use of the revised rule is not disruptive to most 802 U-NII devices. (IEEE 802 at18-19) (WFA at 13) This is an “essential element” of protecting TDWR (Cisco at 34-35) NTIA itself has noted that most instances of TDWR interference have been traced to building-mounted, high-gain antennas with an unobstructed view of TDWRs, used for point-to-point communications links. (Cisco at 35)

But see Cambium at 4, encouraging use of less restrictive rules in areas where there is no threat to TDWR. Also opposing is Fastback, citing the need for higher antenna gain by WISPs in reaching rural and remote areas. Fastback states that improved security measures are enough to protect interference to TDWR. (Fastback at 3-4)

WISPA states that existing high-gain rules are not the source of the TDWR interference – our equipment is more than 75 MHz removed from the problem and as antenna gain increases, beamwidth narrows, making it less likely that high gain transmissions are a problem for TDWR. (WISPA at 13-14, arguing there is “no evidence” that high gain U-NII-3 antennas are a cause of the TDWR problem) WISPA emphasizes the additional distance point to point links can reach with greater dBi – for every 6 dBi in gain, distance doubles. (WISPA at 14) WISPA believes its members should not be disadvantaged by the actions of those who illegally modified equipment, and that manufacturers should improve protections in equipment to make it less susceptible to user changes. (WISPA at 15)

Fastback proposes even more liberal rules for professionally installed point to multipoint systems:

Under the current rules of 15.247 or the proposed revised rules for U-NII-3, deployments of fixed point-to-point systems with a common fixed aggregation end shared amongst multiple fixed remote ends is considered a “multipoint” system and subject to the maximum +36 dBm EIRP transmit power limitation wherein use of greater than 6 dBi antenna gain requires 1 dB reduction in power required for every 1 dB that gain exceeds 6 dBi. This encourages such deployments to be made with a separate co-located aggregation end device for every remote end device such that this maximum +36 dBm EIRP transmit power limitation does not apply either individually or in aggregate across such multiple co-located transmitters. It also permits each remote end to transmit at much higher than this maximum +36 dBm EIRP transmit power limitation since each remote end becomes part of a separate fixed point-to-point system. This leads to unnecessary additional transmit energy in the 5725-5850 MHz as well as additional cost for multiple aggregation end devices and installations.

Fastback Networks believes that partial accommodation for EIRP higher than +36 dBm at a common aggregation end only of professionally-installed fixed point-to- point systems where a professionally-installed common aggregation end fixed transmitter communicates with a small number of professionally-installed remote end fixed receivers is justifiable because such a common aggregation end can advantageously reduce costs and interference simultaneously compared to multiple co- located fixed point-to-point systems. In particular, Fastback Networks recommends that the Commission modify the U-NII-3 band rules to allow an assumed antenna gain of [6 dBi + 10 log (Nremotes)] up to a maximum of 12 dBi (or Nremotes=4) before requiring a 1 dB reduction in maximum power required for every 1 dB that the actual antenna gain exceeds the lesser of either this [6 dBi + 10 log (Nremotes)] limit or 12 dBi. Note that this would leave the maximum power specified at +30 dBm (or +17 dBm/MHz at 20 MHz channel bandwidth) and would not affect 6 dBi assumed gain at the remote end devices. (Fastback at 4)

* + 1. **Master devices must have DFS (Notice- para. 69)**

Supports for fixed access points (IEEE 802 at 22-23, noting possible low power exemption to be discussed below) Wi-Fi Alliance agrees that “responsible operation of U-NII devices in these [2A and 2C] bands is a joint responsibility of both manufacturers and users and supports proposals for master devices (WFA at 18)

Supports OET guidance that a client is a device that cannot initiate, or be configured to initiate, any transmission including probes, beacons, or ad-hoc mode transmissions. If it does so, it must be approved as a master device and have DFS capability. (Cisco at 36-37, noting at footnote 93 that anyone seeking an exemption from the rule has a heavy burden to bear to show no interference to federal radar systems)(Ericsson at 8) (Fastback at 8)

IEEE 802 recommends a **modification to allow a Master to create a list of available channels**. A Master is allowed to perform the channel availability check on multiple channels during device power up per existing Part 15 test methods to ensure that no radar is operating.  In this way a list of “available channels” may be formed and retained by the Master as long as it is powered up. The Master would be allowed to immediately commence operation on any available channel during operation and immediately commence in-service-monitoring . No new CAC would be required immediately before commencing operation on an available channel or switching to another channel in the list of “available channels”.  All other existing channel closing and non-occupancy rules remain in force.  In summary, the Master can operate in one or more of the “available channels” and change its operating channel, without repeating a new CAC before commencing operation on another available channel.  This behavior is recognized in DFS conformance rules in other regions. (IEEE 802 at 24)

Support a DFS **exemption for low power mode**. (IEEE 802 at 26-27) Believes existing DFS rules will limit the types of applications for 802.11 equipment. New Wi-Fi Direct technology is short range, between two portable devices. The 60 second CAC and in-service monitoring regulations have limited the use of these bands by these short-range mobile devices. Today one portable device must act as “Group Owner” and perform the functions of a DFS master. The use cases provided in APPENDIX 1 describe two such restrictions. FCC should consider a low power mode exemption to DFS. (IEEE 802 at 27 and Appendix) (WFA at 18-19 and Appendix) WFA would be pleased to collaborate with the FCC, NTIA and other interested parties to develop a satisfactory low-power profile. (WFA at 19) (Motorola Mobility at 7 – suggesting a power level of 50 mW)

NCTA states that cable industry does not want DFS to apply to U-NII-3. Absence of DFS in U-NII-3 is what makes that band attractive for use today. DFS is complex, causes noticeable delays and service gaps (also noting false positive issue), and makes equipment more expensive. (NCTA at 20-22)

Fastback suggests optional rules for devices that can detect the specific frequency of the incumbent transmitter. DFS detection within a channel should not require the device to vacate the entire channel to the extent that the manufacturer can optionally certify to the Commission that its DFS detection capability can identify the specific frequency range at which the detected radar is operating with sufficient accuracy. Similarly, to the extent that such a DFS detector identifies the specific frequency range of the detected radar, the Non- occupancy period should apply only to that range and not to the entire channel that the device had been operating in. Although most DFS detectors today do not have this capability, so long as the DFS rules provide no optional benefit in this regard, then there will be no incentive to develop such capability and hence no ability to use this capability to more efficiently maximize the beneficial usage of spectrum resources in these bands. (Fastback at 9)

Fastback proposes a version of background scanning - Fastback Networks believes that the Commission should permit devices that can optionally certify the capability to detect incumbent radars per existing requirements and to simultaneously check alternate channels or channel ranges on a partial duty cycle basis. More specifically, if such devices do not detect radar within such alternate channels or channel ranges within a time period greater than some multiple of the Channel Availability Check Time divided by the partial duty cycle fraction, then such devices should be permitted to move to such an alternate channel immediately upon DFS detection in its current channel. This would greatly minimize disruption of service for critical broadband services in the event that DFS radar detection occurs. (Fastback at 9)

* + 1. **Codify guidance to manufacturers preventing users from selecting country code or otherwise altering device to become noncompliant (Notice – para 68-69)**

Supports. (IEEE 802 at 23) (WFA at 17-18) (NCTA at 23)

* + 1. **New spectral density requirement for co-channel sensing (Notice 71-72)**

Notice proposes, for -62 dBm category of devices, an EIRP of less than 200 mW (23 dBm) and an EIRP spectral density of less than 10 dBm/MHz (10 mW/MHz). Mirrors ETSI rule. Supports. (IEEE 802 at 23) (WFA at 19 – will further protect radars) (Cisco at 48-50) (Ericsson at 8)(Fastback at 9)

* + 1. **Unwanted emissions (Notice para 34)**

Agrees with FCC plan to adopt 15.407 approach to unwanted emissions. Rule requires emissions below -17 dBm/MHz within 10 MHz of the band edge, and below -27 dBm/MHz beyond 10 megahertz of the band edge. (IEEE 802 at 19)

But See Cambium at 3,4 (opposing the 15.407 rules) Cambium notes that the transition band of the additional RF filter would reduce the number of channels available – leading to congestion (Cambium at 3-4) States that there is no documented link between 15.247 devices and TDWR interference. Cambium at 4. TDWRs are more likely to be affected by U-NIIs in “2C” than in “3”. Cambium at 4. Benefits of this rule change are unproven. Cambium at 4.

Cambium suggests the FCC amend its Part 15 rules to include out of band emissions from OET publication 789033, where the OET has clarified that the -17 dBm/MHz and -27 dBm/MHz limits relate to peak emissions (which was not clear in Section 15.407) and have determined that these limits are not intended to be more restrictive that the general peak limit of about -21 dBm/MHz. (Cambium at 7)

* + 1. **Eliminate uniform channel spreading (Notice – para. 74)**

Supports. Original rule was to prevent large number of devices from starting up on one channel. With broad channelization of 802.11n and .11ac, rule no longer serves a meaningful purpose. (IEEE 802 at 24) (WFA at 20) (Cisco at 50)(Ericsson at 8) (Fastback at 9) Allow for either random or manual channel selection to give manufacturers greater flexibility to design devices that avoid radar. (Cisco at 50) Agrees that either random or manual channel selection should be allowed. (IEEE 802 at 24)(Fastback at 9)

* + 1. **Revise the channel loading test for DFS (Notice – para. 74)**

IEEE 802 recommends that the current channel loading file approach be replaced with a test which consist of packet transmissions that together exceed the transmitter minimum activity ratio of 30% measured over an interval of 100 ms. The required traffic loading can be generated either via audio or video streaming, data file transfer, or using network testing tools that can generate data streams (e.g., iperf, Chariot, etc.) – consistent with ETSI (EN 301 898). (IEEE 802 at 24)(WFA at 20) (Cisco at 50-51)(Fastback at 9)

* 1. **Additional measures unnecessary to protect TDWR**

Revised and uniform application of 15.407, including more stringent antenna gain requirements and improved security, together with previously-announced guidance limiting user configuration capability, are sufficient. Balance of Notice proposals, below, are unnecessary and burdensome. (IEEE 802 at 19-20) (WFA at 10, 21 – WFA “strongly opposes” additional measures) Strengthening TDWR protection is best accomplished by rule changes that address the problems that have been identified - retuning devices into unauthorized bands, operating unlawful equipment with emissions characteristics at odds with band requirements, and operating without DFS. (WFA at 21) Cisco’s support for the measures it has supported to address TDWR interference is conditioned on the Commission rejecting calls for additional restrictions designed to “fix” problems that have never materialized. (Cisco at 37)

Assumes TDWR band is permanently closed - Additional measures should be “optional” if manufacturer can show its device has been prevented from transmitting in 5600-5650 MHz. (Fastback at 7)

* + 1. **Geolocational database (Notice – paras. 54-56)**

Opposed (IEEE 802 at 3, 20-21) (Cisco at 40) Prior industry agreement that outdoor systems should be subject to a database presumed no changes to certification rules, and that professional installers could manage database registration. (IEEE 802 at 20) (WFA at 22 and footnote 69 – if FCC finds that improved security is insufficient to protect radars from outdoor devices, then apply database to outdoor devices only) (WISPA at 17, noting that a registration database should not be mandated & that it plans to continue the voluntary database it started, along with education for its members)

U-NII devices properly operating with DFS render a database unnecessary. (WFA at 22) Not that many TDWR locations to warrant a database – this requires further study, but may not be worth the effort. (Ericsson at 7) (See generally Shared Spectrum, supporting sensing based approaches to sharing at 2-3; but notes that a database approach could be an “alternative” to avoid TDWR – at 5)

Unlike a “greenfield” band (e.g., TV white spaces), imposition of a database would significantly alter devices deployed. (IEEE 802 at 20) (Cisco at 40) Consumer expectations about devices and price points that would be upended. (IEEE 802 at 21)

Significant unanswered questions raise uncertainty – who pays for, maintains, accesses database? (IEEE 802 at 20-21 – noting that the merits of databases in the 2B band are not yet fully understood) No technical capability today to identify and provide location data. (Cisco at 40)

CSMAC did not mandate databases. Final proposal shows recommendations were more open ended. (IEEE 802 at 21) (Cisco at 39 and footnote 97)

*But see* GOOG/MSFT at 7-8. GOOG/MSFT promote geolocational databases as a good mitigation technique that may be less difficult and burdensome than DFS. For TDWR, those transmitters, like broadcast TV, are in known fixed geographic locations that a database could readily identify and protect. Could protect other governmental fixed users. Implementation should be easy because many unlicensed devices have locational awareness capability, and the cost of establishing a database is minimal. (*See also* NAB at 4-5, 6-7 – supporting databases and noting that they could work to protect broadcaster weather radar. )

Also supporting a database is Spectrum Bridge. It proposes that all radios that operate in the revised 5 GHz band be required to query a policy database on a regular interval. Note that Policy is different from frequency assignment. Policy includes the ability to affect operational parameters such as maximum transmit power and spectral mask information. The use of a Policy database creates an efficient, manageable, extensible, and future proof solution for managing various operational scenarios that exist in the band today and that may exist in the future. The Policy database should be used in conjunction with complementary technologies such as dynamic frequency selection, sensing and geo-­‐ location databases, which would also be implemented as part of the Policy. (Spectrum Bridge at 1-2) Database would not replace sensing, but govern its capabilities. Policy database should be applied across the 5 GHz band. (Spectrum Bridge at 3-6)

But see Cambium at 2-3. Cambium supports a database for devices operating near TDWRs, with a requirement that the device communicate with the database periodically or at restart. Notes that not all devices are today connected to the public Internet (and there may be security reasons for that) and that not all devices have GPS, and if they do, in an indoor installation, GPS is not helpful.

Manufacturers should be encouraged to provide optional capabilities in their products or associated management systems to simplify or automate the database access and registration process. Manufacturers should also be obliged to provide instructions in User Guides to explain the registration process. Cambium at 3.

Motorola Mobility is also willing to consider databases if it can trade off the database with permission not to utilize DFS when a device is not near a radar. (Motorola Mobility at 7)

* + 1. **Unwanted emissions (Notice – paras. 57-61)**

Opposed (IEEE 802 at 3, 21) While Notice suggests tightening unwanted emissions for outdoor devices, no enforcement case to date shows that adjacent channel emissions caused interference to TDWR. Given how critical 802.11 equipment is for deploying broadband, FCC should not regulate unless there is clear evidence that the cost of regulation does not exceed the benefit. In this case, benefits are speculative, but costs are real and will degrade the utility of equipment. (IEEE at 21-22) (WFA at 23) (Cisco at 38 – proposed rule is “belt and suspenders” and not based on any instances of OOBE caused interference)(Ericsson at 7-8, but if do adopt it apply only at the upper and lower edges of 5 GHz – not to each subband)

Other rules (discussed above) adequately and specifically address the issues with TDWRs. (IEEE at 22)

No case involving out of band emissions and Wi-Fi. (WFA at 23)

Opposes OOBE rules that differ as between “indoor” and “outdoor” devices. (Fastback at 7) Opposes an out of channel limit of -41 dBm/MHz as impossible to meet. (Fastback at 8)

* + 1. **Frequency separation/sensing (Notice – paras. 62-65)**

Opposed (IEEE 802 at 3, 22) FCC should not adopt a rule requiring U-NII devices to transmit at least 30 MHz away from a nearby TDWR. No evidence this is a problem. (IEEE 802 at 22) (WFA at 23-24)(Cisco at 38)

Implementation of this proposal would require a fundamental change in how U-NII devices operate. Today, U-NIIs sense for radar emissions within their occupied bandwidth, but do not detect the specific frequency the radars are using. Adoption of this proposal would require U-NIIs to identify that frequency in order to be able to meet the 30 MHz separation requirement. This is expensive and will add to congestion, and should not be adopted absent some evidence that adjacent channel interference is a problem. (Cisco at 38-39)(*See also* Ericsson at 8)

Opposed to requiring bandwidth sensing over 100% of bandwidth instead of 80%. No evidence this is a problem. (IEEE 802 at 22) (WFA at 24) (Cisco at 39) No reason to subject all U-NII devices to this, when only outdoor has been an issue in the enforcement cases. (Cisco at 39) FCC knows that existing rules have produced commercial equipment that effectively sense 100% of bandwidth. If stricter rule is adopted, manufacturers would have to increase sensing which will increase rate of false positives. False positives impose a cost because the device must switch channels – initiating a channel availability check. End result – radar is not better protected (because it is protected by the current rule) but U-NII performance is degraded. FCC should not adopt this proposal. (Cisco at 40-41) *But see* NAB at 5 (supporting 100% occupied bandwidth sensing) and Shared Spectrum at 5 (also supporting)

1. **Rule changes that can be adopted immediately**
	1. **Extend U-NII-3 by 25 Megahertz (Notice – para. 29)**

Support. (IEEE 802 at 17, 26 – improves U-NII access to the band) (WFA at 11-12 – rules will be “clear and consistent”) (Cisco at 42) (TIA at 11 – unlikely there will be much debate about this)(Ericsson at 4) (NCTA at 17)(Motorola Mobility at 2,3)(Fastback at 2) (First Step at 3) (WISPA at 12)

Adopt conforming edit to 15.403(s). (IEEE 802 at 26) (WFA at 11, 31)(Cisco at 43)

* 1. **Amend 15.407(a)(3) to provide that maximum output power is up to 1W (Notice- para. 30)**

Support. Agree that this change does not contribute to the interference environment because 15.247 allowed certification up to 1W. (IEEE 802 at 17) (WFA at 12) (Cisco at 43) (Ericsson at 5)

* 1. **Adopt proposed changes to power spectral density requirements (Notice – para. 31)**

Support. Above a 20 megahertz emission bandwidth (e.g., Wi-Fi), the 1 Watt power limit becomes the limiting parameter, and the PSD is the same for equipment certificated under either Sections 15.247 and 15.407 (IEEE 802 at 17) (WFA at 12)(Cisco at 44) (Ericsson at 5)

* 1. **All U-NII devices to have minimum 6-dB bandwidth of 500 kilohertz (Notice – para 32)**

Agree with proposes to change the rule in Section 15.407 for emissions bandwidth, and replace it with the Section 15.247 requirement. This would change the minimum emissions bandwidth limit from 26-dB to 6-dB. (IEEE 802 at 18) (WFA at 12-13, 20) (Cisco at 45) Cisco would apply this rule to ALL 5 GHz U-NII bands to help ensure that 5 GHz does not become congested with narrow bandwidth applications for which other spectrum is available. (Cisco at 45) (*See also more generally* - FCC should act to “minimize congestion” as is occurring in 2.4 GHz. TIA at 8)

* 1. **Adopt proposed modification of measurement bandwidth in 15.407(a)(5) (Notice – para. 31)**

Support FCC proposal. The measurement bandwidth to 1 megahertz; using 3 kHz may increase measurement time; proposes 33 dBm/1 MHz to reduce the measurement time (IEEE 802 at 18) (WFA at 12)(Motorola Mobility at 4)(Cisco at 46, noting there is a separate open docket on testing procedures and seeking clarification that nothing decided in the 5 GHz proceeding will impact a manufacturer’s ability to demonstrate compliance under ANSI C63.10-2009) Cisco notes that the issues raised by multiple antenna ports in MIMO antenna configurations are being discussed separately from this docket, and should be resolved in a future KDB. Until that issue is resolved, the FCC should clarify that using the 1 MHz bandwidth for testing does not require determining if any part of the signal from the antenna port is correlated across the band. (Cisco at 46, noting draft KDB 662911)

*(note – antenna gain in para 33 appears in TDWR section, above)*

* 1. **More restrictive emissions limits in 15.407(b) should be adopted (Notice – para 34)**

Agrees with FCC plan to adopt 15.407 approach to unwanted emissions. Rule requires emissions below -17 dBm/MHz within 10 MHz of the band edge, and below -27 dBm/MHz beyond 10 megahertz of the band edge. (IEEE 802 at 19)(Cisco at 47) (Motorola Mobility at 4)Agrees - No adverse affect to Wi-Fi devices. (WFA at 13) (Cisco at 47 – noting that over time, RF environment will improve)

* 1. **Peak-to-average ratio limit of 15.407(a)(6) should be retained (Notice- para 35)**

Supports 13 dB peak-to-average radio across any 1 MHz band. (IEEE 802 at 19) (WFA at 13-14) (Cisco at 48)

* 1. **Adopt proposed Bin 1 changes to DFS sensing rules and test procedures (Notice – para. 73)**

Supports. (IEEE 802 at 23) (WFA at 9, 17)(Cisco at 28-29)

* 1. **Miscellaneous rule changes –adopt (Notice - Para. 113)**

Supports. (IEEE 802 at 24-25) (WFA at 31) (Cisco at 51-52)(TIA at 11)(Ericsson at 12)

* 1. **Adopt proposed transition plan (Notice- para. 114)**

Adopt plan – after 12 months, new certifications will have to comply to new rules; 24 months from date of rule change to cessation of permissive changes to formerly compliant equipment. (IEEE 802.11 at 25) (WFA at 31) (Cisco at 52, noting that the timeline should begin upon the effective date of the new or modified rule, not Federal Register publication)(Ericsson at 12, noting that existing devices should be grandfathered) (NCTA at 13,18– allow “reasonable” period for manufacturers to adapt and recommending extending the time to 18 months) But see Cambium at 5 (two years is not long enough and need a longer period) and WISPA at 18-19 (asking to add 12 months on to each of the FCC proposals).

One exception – after 2 years, allow manufacturers to update formerly compliant equipment with new Bin 1. Policy – help ensure devices have more recent DFS detection. (IEEE 802 at 25-26)(WFA at 31-32) (Cisco at 52-53)

Supports grandfathering of existing equipment. (Cisco at 53-54). (NCTA at 25)Agrees that requiring an upgrade would be a financial burden, and difficult to enforce. (Cisco at 54) (First Step at 5) (WISPA at 18)

1. **U-NII-1 (Notice – para. 37-41)**
	1. **Harmonize with U-NII 2A or 3 & allow outdoor operation**

Harmonization across the entire 5 GHz band (if feasible) is a good thing because manufacturers can build one set of equipment that works throughout the band. (CEA at 12-13)

Harmonize with U-NII 2A (IEEE 802 at 27) (WFA at 24)(Ericsson at 5) (Motorola Mobility at 2) Provides a 200-MHz wide band to enable new generation of products that is not possible under today’s allocations. (IEEE 802 at 27-28) (WFA at 25) Band today is being underutilized, and can be more intensely used by U-NII devices if the proposed rules are adopted. (WFA at 25) (TIA at 3 – generally supporting harmonization to the maximum extent possible consistent with providing appropriate protection to incumbents)

Harmonize with U-NII-2A at a minimum, and seriously explore possible harmonization with U-NII-3. (Cisco at 54)

Harmonize U-NII-1 with U-NII-3 – power levels and no indoor only restriction. (NCTA at 2,12-13) (Time Warner Cable at 3, 10) (Cablevision at 4,6) (WISPA at 9 – better coverage for rural areas and reduces interference in networks using higher power point to point configurations) No DFS required. (NCTA at 13) (Time Warner Cable at 13) (Cablevision at 4,7)Current limits on U-NII-1 mean that cable companies cannot use it in their outdoor deployments. If aligned with U-NII-3, operators can use equipment with channel bonding capability to deliver 160 MHz wide channels. While not as efficient as a single 160-MHz wide channel, a bonded 160 MHz channel increases capacity. Adopting higher power also would conceivably allow a 160 MHz channel across U-NII-1 and U-NII-2A, but the 250 mW power limit makes the channel useful only for a subset of applications. (NCTA at 13-14) (Cablevision at 4) U-NII-3 power is better because it improves range, coverage and throughput. At U-NII-3 power levels, the U-NII-1 band would be useful for whole home networks and would reduce cost of network builds. (NCTA at 14-15) (*See also* Time Warner at 10-11 - would make the band suitable for mesh and outdoor use) Higher power (at U-NII-3 levels) helps signals go through obstructions and makes band more useful for outdoor deployment. (Cablevision at 4-5) Even if devices operate at less than 1W, higher access point power improves signal quality, and helps users when they are downloading data. (NCTA at 15)(Cablevision at --65 – improves data rates, modulation, throughput when downloading). Eliminating the indoor only restriction is also important, given how consumers use U-NII devices. (NCTA at 15-16) (Cablevision at 6) Quoting Thanki study, notes that outdoor Wi-Fi helps mobile data offloading (Cablevision at 6 – without Wi-Fi, mobile operators would have to make large investments in new towers)

Fastback says the FCC cannot enforce “indoor only” because devices are used outside, and therefore supports designating U-NII-1 as indoor/outdoor. (Fastback at 5)

Fastback offers a proposal for two categories of equipment in the U-NII-1 band. “Professionally-installed fixed devices” must be designed, certified and installed such that their maximum EIRP in an upward pointing direction that may affect satellite receivers does not exceed a prescribed limit. The “transportable devices”, which would be defined as anything not qualifying under “professionally-installed fixed devices”, are not so certified and cannot be assumed to be always oriented to minimize interference in an upward pointing direction that may affect satellite receivers. Thus the “transportable devices” should have a maximum EIRP in any direction that also does not exceed this same prescribed limit. (Fastback at 5-6)

For Transportable devices, Fastback proposes the status quo: maximum EIRP to a prescribed limit of 200 mW or +23 dBm (or +10 dBm/MHz). Fastback Networks suggests that the conducted output power limit for such “transportable devices” be limited to 50 mW at a peak power spectral density of 2.5 mW/MHz as per current U-NII-1 band rules. However, Fastback Networks accepts that it may be completely reasonable to allow a higher conducted output power limit for such “transportable devices” so long as the maximum EIRP of 200 mW is demonstrated. (Fastback at 6)

For professionally installed devices, Fastback favors U-NII-3 rules but add the restriction that such “professionally-installed fixed devices” must be designed, certified and installed such that their maximum EIRP at any elevation angle greater than 45 degrees above the horizon be less than the same prescribed limit of existing U-NII-1 devices of 200 mW or +23 dBm (or +10 dBm/MHz). (Fastback at 6)

Time Warner Cable also wants to ensure rules allow point to point links of the type used in mesh deployments. (Time Warner Cable at 13)

As proposed, increase the power limits to 250 mW with a maximum EIRP of 30 dBm with 6 dBi antenna gain, increase the PSD limits to 11 dBm/MHz, and eliminate the restriction on outdoor operation. (WFA at 25) (IEEE 802 at 27, including harmonizing PSD limits) (Ericsson at 5)

Allow outdoor operation for all devices. (IEEE 802 at 27) (Cisco at 54-55, 57) (Ericsson at 5) (Motorola Mobility at 5) (GOOG/MSFT at 5-6 – sharing techniques less onerous than an indoor restriction can work and favoring harmonized power levels) (Cablevision at 6) (CEA at 11 – noting “harmonize where feasible” principle). Indoor restriction is a legacy of past allocations and is no longer relevant. (CEA at 12-13, also listing the benefits of harmonization: enabling manufacturers to scale lowers equipment costs, speeds certification & therefore speeds innovation to market, supports 802.11ac) (WISPA at 6)

WISPA favors establishing geographic protection zones around fixed satellite services, requiring professional install and incumbent agreement to install within the protection zone. (WISPA at 11, nothing that there are only 5 locations, predominantly rural.)

WISPA also believes that the Commission can adopt appropriate out-of-band emission limits for both U-NII-1 devices and any operations that may be authorized in the pending proceeding to protect the 5091-5150 MHz band for Aeronautical Mobile Telemetry from adjacent-channel interference. (WISPA at 11)

Geolocational databases can protect MSS feeder links, and allow U-NIIs to increase power levels in areas away from feeder link locations. (GOOG/MSFT at 8-9, noting the similarity to TV white spaces)

With rule changes, band could be used for public hotspots and service provider Wi-Fi networks, helping to address mobile data offloading. (WFA at 25)

“Indoor only” restriction is blocking the ability of Wi-Fi Direct to use the band, even when some of the devices (“peers”) are indoors. (IEEE 802 at 28 and Appendix. )(WFA at 25 and Appendix)(See also Motorola Mobility at 5-6, supporting Wi-Fi Direct use in this band)

Within the U-NII-1 band, the minimum 6 dB bandwidth of U-NII devices should be at least 500 kilohertz. (WFA at 25)

* 1. **Factors that have changed since initial allocation**

Use of Wi-Fi and importance to broadband ecosystem require FCC to examine the very conservative choices made in 1997 concerning protection of MSS feeder links. FCC recognized its choices were conservative, stating that it would reexamine if MSS proved to be more resistant to interference than expected. (Cisco at 55)

Models used by NTIA in its report provide a far better prediction of U-NII devices relative to doomsday predictions presented back in the 1990s. U-NII devices are deployed at relatively low heights. The older models assume free space path loss, and do not account for ground clutter. At the time, regulators were assuming that U-NIIs would be 10 MHz-wide HiperLAN devices, having 2X the PSD of Wi-Fi. And, more bands have been opened for unlicensed use so that outdoor uses are not exclusively directed at a U-NII band or even 5 GHz. (Cisco at 56, noting satellites have evolved as well, with the higher orbit LEO-F satellites having never been deployed. The lower earth orbit LEO-D satellites see approximately 9 percent of the Earth at a time, while the LEO-F satellites were designed to see 31 percent).

* 1. **Opposition**

Globalstar opposes outdoor use of U-NII-1. Threatens substantial harmful interference to Globalstar’s MSS feeder link operations at 5096-5250 MHz. (Globalstar at 1) FCC should maintain current rules. (Globalstar at 4)

Presents technical appendix, summarized in its comment. Under existing indoor-only rules, over 200,000 U-NII devices can operate simultaneously without causing interference to Globalstar’s uplink facilities. If outdoor, that number would be 4,000. If U-NII-2A power limits were applied outdoor, the number would be 798, and if U-NII-3, then just 201. (Globalstar at 5)

Appendix also finds that if 70,000 hot spots were operational outdoors, that would raise the noise floor 26%. If power levels were raised to U-NII-2A or 3, then the noise floor increase would be 131% or 522%, respectively. This would result in chronic, harmful interference, affecting service in the US, Canada, the Caribbean, Mexico, Central America and parts of Russia and Japan. (Globalstar at 5-6) If indoor only restriction maintained, then raising the power level to match U-NII-2A raises the noise level for Globalstar’s feeder link operations by only 2.6%. Globalstar calls this “manageable”. However, Globalstar says that if the FCC decides to raise the power levels to match 2A, then the FCC will need to take this into account when considering possible co-primary aeronautical radionavigation uses in the future. (Globalstar at 6 & footnote 18)

Globalstar has spent $1b on its second-generation MSS facilities, and must have access to interference-free spectrum.

* 1. **Other/history**

Globalstar was first licensed in 1995 for non-geostationary mobile satellite network. Constellation of satellites, plus ground stations on six continents, provides service to 550,000 customers globally. Uplink licenses at 1610-1618.725 MHz and downlink at 2483.5-2500 MHz. Feeder links(between its gateway earth stations and space stations) use uplink of 5096-5250 MHz, and downlink at 6875-7055 MHz. Has 24 second-generation satellites in orbit with design life of 15 years. Constellation sees 5 billion POPS and can provide voice. (Globalstar at 1-3)

Noting that NTIA may consider relocating aeronautical radionavigation from 1755 MHz to U-NII-1, NCTA advises that the FCC should nevertheless proceed with U-NII-1 changes here, due to the uncertainties about whether this move will ever occur. (NCTA at 16-17) NCTA further states that since this band is not home to other government services, it makes no sense to put government services into the band. (NCTA at 17)

1. **U-NII-4**

Generally supports opening the band. Act in a technologically neutral manner and afford suitable protections for incumbents. (TIA at 3) (Fastback at 10) (WISPA at 6 – supports opening the band and prefers outdoor uses)

* 1. **Agreement on DSRC as primary & licensed – no harmful interference**

The 75 megahertz of spectrum is important to allow .11ac take advantage of greater channel bandwidths. (WFA at 26) (Cisco at 57) Advises FCC to consider benefits to .11ac and measures necessary to protect incumbents. (WFA at 26)IEEE 802 strongly prefers a set of FCC rules that will allow both sets of technologies to flourish. (IEEE 802 at 29) DSRC is designed to improve vehicle safety and to warn drivers of dangerous conditions – requires dependable, secure, low latency application to perform. (IEEE 802 at 29-30)

DSRC are licensed by rule, and are therefore primary. Issue is whether there will be spectrum at any given location, at any given time, that is not in use by DSRC and which could be used by U-NIIs if U-NIIs cause no harmful interference to DSRC. (IEEE 802 at 30)

IEEE 802 wants both technologies to succeed (IEEE 802 at 29, 30) (TIA at 16)

Imperative that introduction of U-NII devices does not result in unwarranted interference to incumbents. Spectrum Act reflects Congressional concerns. Asked NTIA to study the risk to Federal users. FCC must assure that Congress’s concerns are fully and fairly addressed. (Cisco at 58, 62) Providing DSRC with the necessary protection against harmful interference is essential. (Cisco at 62-63) (CEA at 14-15, 16 – need to protect DSRC in its “nascent state”)

Notes the Spectrum Act did not provide a specific test for protection of U-NII-4 incumbents, but states that the more general public interest test “will be its lodestone in evaluating the opening “ of U-NII-4. TIA at 14. TIA is “particularly concerned” that the FCC provide appropriate levels of protection for DSRC. (TIA at 15-16 – interference protection is “critical”) (ACEA at 2 – important to avoid radio interference with the safety related services in the ITS communications system)

Qualcomm “strongly committed” to providing speedy deployment of DSRC. (Qualcomm at Summary I, 1-2) FCC should take no action that will delay or jeopardize achieving important objectives of DSRC, and specifically the NHTSA’s upcoming decision on DSRC. (Qualcomm at summary i) Qualcomm also a leading supplier of Wi-Fi chips, and wants to explore whether the policy objectives of DSRC and expanded U-NII spectrum access can be reconciled. (Qualcomm at summary i)

It is no answer to the spectrum crunch to order spectrum sharing between the two services if doing so will result in harmful interference to DSRC. But it is also no answer to the spectrum crunch to simply rule out ideas for how to arrange the spectrum more efficiently if it is clear that this can be done in a manner that guarantees the absence of harmful interference to safety communications and avoids any adverse impact upon the rollout of DSRC. (Qualcomm at summary ii)

All DSRC stakeholders would agree that DSRC requires an interference-free environment, and any uncertainty surrounding this could derail the entire effort. Quite simply, the 5.9 GHz band is essential for connected vehicle safety applications, and these enhanced safety features contain stringent communication requirements that must be protected. (GM at 2) (AAM-GA at 2-3, 33 DSRC requires “significant” protection)(Omni Air at 1) (*See Generally* Mercedes Benz comments, similar to GM; Savari Comments at 30-32, noting the Notice recognizes that DSRC is primary and U-NII operations must not interfere) DSRC has “valuable protections” from interference, per FCC rule (CA DOT at 2) (See generally NTSB 1-4)

Supports Alliance request that FCC allow for “proper due diligence” on whether 5.9 GHz can accommodate sharing. Examination needs to be focused and disciplined, data-driven, because up to now there has been no testing. (GM at 2-3) While GM recognizes the importance of increasing spectrum for unlicensed U-NII devices, proper consideration must be given to prevent any potential harmful interference to DSRC technology in the 5.9 GHz band. (GM at 3) (See also CA DOT at 2)

Sufficient protection must be assured before a decision is taken – validated in large scale field operational tests. (ACEA at 2)

* 1. **DSRC - Specific proposals for sharing**

Qualcomm proposes to take sharing “off the table” for safety-related services, and to allow .11ac to operate only on a shared basis in another portion of DSRC spectrum on a “secondary” basis if it can be demonstrated that U-NIIs will not cause interference. (Qualcomm at summary iii-iv, 2) (*But see* AAM-GA list of concerns, in “Opposition section below – calling out adjacent channel issues)(AASHTO also opposes relocation because it will “compromise the communications options offered by DSRC for safety applications benefiting travelers”; this in turn will affect “viability” of connected vehicle. AASHTO at 17)

Qualcomm proposal would make a broad swath of spectrum available for .11ac, without impairing DSRC. Notes that the uppermost part of the DSRC spectrum would fall outside of the .11ac channel plans for 40/80/160 MHz channels. Using that uppermost piece will provide “absolute protection” to DSRC safety services. In this way, the safety services can roll out unimpeded, while the FCC and NTIA can focus on whether the lower 45-55 MHz can be shared without harmful interference. (Qualcomm at summary iii-iv, 2) Uppermost 20 or 30 MHz would be retained for exclusive DSRC use (Qualcomm at 3, 8)

Qualcomm presents two options – one for exclusivity of 20 MHz and the other for 30 MHz. The “pro” of the 20 MHz plan is that Wi-Fi would have a 10 MHz guardband (5895-5905) next to its allowed spectrum the top end of which would be 5895 MHz. A 30 MHz options provides more exclusive spectrum for DSRC, but requires a more restrictive OOBE rule for U-NIIs relative to the first option, and thereby caps power levels somewhat. (Qualcomm at 8-12 – presenting various tables and figures to illustrate)

Requires critical safety channels to be moved to Channels 182/184 or possibly Channel 180. These channels have the same bandwidth and virtually identical physical layer properties to those channels already tested, and would minimize the need for additional safety studies. (Qualcomm at 9) Using existing QoS enhancements already in .11 would allow DSRC to be treated with a higher priority. Qualcomm at 12)

Benefits – simplifies sharing R&D and verification testing; does not adversely affect .11ac operations; helps the timeline for DSRC roll out (Qualcomm at summary iv, 3) Plan is “viable and minimally disruptive & limits risk and uncertainty. (Qualcomm at 2) Can be readily manufactured from existing chip designs. (Qualcomm at 3)

In the lower 45-55 MHz, both remaining DSRC and .11ac should use 20 MHz wide transmissions and consider implementing the priority mechanism in the .11e standard to prioritize DSRC. (Qualcomm at 3) Easier for U-NIIs to detect preambles and identify DSRC packets if both are “speaking” in 20 MHz increments.(Qualcomm at 12) For lower/shared channels, because DSRC is on a 20 MHz channel, there is greater access to the spectrum for U-NIIs. (Qualcomm at 12-13)

Packet error rate performance is the main concern with 20 MHz channelization – the pilot tone spacing of the 20 MHz channel doubles that of the 10 MHz channel, which may increase channel tracking errors in challenging environments, and the delay spread in some mobility environments can be larger than the guard interval of the 20 MHz channel and create inter-symbol interference, degrading the Signal/Noise ratio. (Qualcomm at 13)

DSRC is challenged by mobility (coherence times are as short as 0.25 to 0.30 ms for vehicular safety applications) and rich multipath brings in frequency selectivity and narrows the coherence bandwidth to as allow as 410 kHz for DSRC. Therefore, must have good channel tracking in both time and frequency.(Qualcomm at 13) The 20 MHz introduce larger channel estimation errors, but that is overcome with shorter packet duration. Shows an analysis of packet error rate performance comparing 10 & 20 MHz channels, with 20 MHz outperforming 10 MHz when cars are traveling in excess of about 65 miles per hour. Mentions and dismisses worries about excessive delay spread, noting the effects are small. (Qualcomm at 14-16)

Other thoughts on potential sharing--

Candidate for DSRC is now 802.11p, part of the 802.11 family of technologies that share some capabilities. Much overlap in the industry in terms of companies and engineers with an interest in both. (IEEE 802 at 29)(WFA at 26)(Cisco at 63) (TIA at 16 – but noting that the rules for sharing will need to be technology neutral)(*But see* ACEA at 2 – V2V and V2I have “different system architectures and specific parameters compared to U-NII devices)

DSRC sharing is a “new” problem. Comment cycles are not a good place to resolve detailed technical issues of sharing with DSRC. Parties need to deeply understand what is being asked of the technology. DSRC was not designed to share. (IEEE 802 at 30) (WFA at 26-27) There has been no testing of U-NII devices ability to share with DSRC to date (AAM-GA at 8)

No consideration of, or practical experience with, U-NII sharing of DSRC up until this point. (Cisco at 64) (GM at 2)

Notes that NTIA report does not contain a technical solution, and notes that usual mitigation techniques for U-NII sharing may not apply. (ACEA at 2)

AAMI supports use of a geolocational database or “other mechanism” proposed by FCC. (AAMI at 6)

If the entire 75 MHz were opened to U-NII sharing, it is “clear” that harmful interference to DSRC will result. (Qualcomm at Summary iii, 6-7) Impossible to eliminate interference from U-NII because of ubiquitous use of Wi-Fi. Issues: Proposal to share safety channels will invalidate results of prior testing, resulting in DSRC delay. DSRC operates with a 10 MHz clock and is not detectable by Wi-Fi. New signal detection techniques need to be developed - resulting in delay. Uniform conformance of U-NII devices to a priority scheme in the presence of DSRC signals may be “difficult to enforce.” (Qualcomm at 7, 13) Notes that if DSRC has priority, where there are vehicles, Wi-Fi won’t be able to take advantage of spectrum (Qualcomm at 7-8)

Posits a geolocational database could assist with sharing between U-NIIs and DSRC, given that widespread use of DSRC won’t occur for years. Geolocational database could be use to force U-NIIs to exit the band at the appropriate time (GOOG/MSFT at 10)

Cambium expresses concern about a variety of sharing mechanisms. Signal sensing might be difficult or expensive if the two radio systems have different air interfaces. Cooperative sensing might give rise to security challenges. Geolocation solutions may not work if the incumbent is mobile or nomadic, if the incumbent cannot reveal its location for security reasons or the U-NII cannot access the public Internet. Additional protections might be needed for directional antennas. Beacons require additional receivers. Notes the discussion of beaconing in the NPRM does not align with IEEE 802.22’s version, which protects a specific transmitter, telling other devices not to transmit, but says it is not clear how it would work when applied to a distributed network. (Cambium at 5-6)

Never a better moment to put a sharing mechanism in place for DSRC because there are no deployed incumbent systems yet. Fourteen years have passed since the original DSRC allocation. Devising a sharing mechanism once an incumbent is in place is harder than deploying a mechanism from the beginning. It’s clear that it will be many years before ITS-equipped vehicles are on the market, and decades before it is widely deployed. The FCC cannot allow the spectrum to lie fallow in the face of huge demand for U-NIIs. (NCTA at 19-20)

Toyota is not “conceptually opposed” to sharing, but FCC must do its homework with other agencies and technical due diligence to assure minimal interference risk. (Toyota at 1-2) Has great confidence in DSRC as designed to improve automotive safety. (Toyota at 4-5)

WISPA suggests possibility of “partial reallocation” noting lengthy period between DSRC allocation and deployment. (WISPA at 8)

* 1. **DSRC – OPPOSITION TO SHARING**

Oppose. (Utah DOT at 1) Collectively, industry and state/federal government has invested millions in this technology to improve V2V and V2I safety. Proposals to to share 5.9 GHz introduce “enormous potential risk” to viability of DSRC. (Utah DOT at 1,2)(Colorado DOT at 1) Caltrans has spent close to $7 million (CA DOT at 1)

Greatest concern is power levels – up to 4 W omnidirectional and up to 200W point-to-point. At these levels, significant potential for interference with 400 mW DSRC. Needs testing before FCC can proceed. (CA DOT at 2)

Encouraged by NTIA evaluation of potential risks, and their inclusion of DSRC in their report. NTIA has concluded that U-NIIs may not be able to detect DSRCs signals and DSRC may experience performance degradation. (Utah DOT at 1-2) (Colorado DOT at 1) Allowing sharing will compromise and degrade the critical advantages DSRC has to assist with safety. (Utah DOT at 2) (Colorado DOT at 1) Sharing the spectrum could jeopardize critical safety applications, impede our ability to improve transportation mobility, a key economic driver, and put at risk significant investments in DSRC. (Utah DOT at 2.)(Colorado DOT at 2) Preserve the band solely for DSRC. (Utah DOT at 2) (Colorado DOT at 2)

“Grave concerns” about allowing U-NIIs to share DSRC spectrum. Technology will only be effective and viable if it can operate in an interference-free environment (AAM-GA at iv) “Skeptical” that two technologies can share without causing persistent, harmful interference to V2V and V2I (AAM-GA at iv, 6). “Calls into question the viability” of US DOT connected vehicle program. (AAM-GA at iv) Could cause co-channel, adjacent channel and OOBE interference to DSRC. (AAM-GA at 6-7) Concerns about U-NII ability to detect DSRC and increasing congestion in band from U-NII. (AAM-GA at 6-7 & Technical Appendix) anything short of a deliberate, data- driven testing process for evaluating U-NII/DSRC compatibility will raise serious concerns regarding the viability of DSRC. (AAM-GA at 9) (AASHTO at 9) (See also Ford at 1-2)

FCC itself recognized when setting up DSRC that the applications are “exceptionally time sensitive and should not be conducted on potentially congested channels” (AAM-GA at 23, 24-25) Even infrequent cases of harmful interference are not tolerable by safety of life applications. (AAM-GA at 23)

Increased latency, loss of packets, degraded security functions – these all decrease the benefits of DSRC (AAM-GA at 23-24) DSRC equipment must be capable of communicating on the same frequency and in the same language, include security features and manage channel loading. Uncontrolled U-NII signals will be problematic and negates benefits of DSRC. (AAM-GA at 25-26) Without assurance against harmful interference, promise of connected vehicles will be unfulfilled. (AAM-GA at 26)

Goal of finding more spectrum for U-NIIs should not be elevated above the safety of life application of DSRC. (AAM-GA at 3)

Expresses “concern” that compatibility between U-NIIs and ITS systems “will not be possible and will only further day the process toward implementation and deployment of C-ITS in the US and Europe.” (ACEA at 3)

There is no technical support for the idea that sharing will be successful (ACEA at 3,4)

Allowing **outdoor U-NII use** in the band and **peer-to-peer communication** within a vehicle would create unacceptable and harmful interference with C-ITS services. (ACEA at 2, 3 – noting this is particularly a problem for low latency services) (*But see* GOOG/MSFT at 5, favoring outdoor use across 5 GHz)

AAM-GA has a technical appendix where it raises issues on sharing that it says will have to be resolved. This is summarized in its comment beginning at page 27. Each section ends with a recitation of the consequences of interference, not summarized here. Issues identified are:

**Detection issues due to channel size disparities**: co-channel. Could create lower layer sensing conflicts. 802.11ac is 20 MHz wide; .11p is 10 MHz wide. Wi-Fi would need to be modified & be capable of monitoring 2 or more channels. Nomadic nature of transmissions and fact that V2V do not continuously transmit adds to the challenge. (AAM-GA at 27-28)

**Power Limit Disparities and Sensing Concerns**: co-channel. DSRC has much lower power than radars. V2V operates at 18-20 dBm EIRP. Notice proposed much higher power levels for U-NIIs. (AAM-GA at 29)

**Channel Congestion:** co-channel. Increase in congestion from U-NIIs raises noise floor. Compounded by FCC lack of control over users. Even indoor use is a problem because FCC cannot exercise adequate oversight and user can just walk outside. (AAM-GA at 29-30) (AASHTO at 8)

**Adjacent channel:** key concern here is Channels 172 and 184. Concern is higher power U-NIIs (AAM-GA at 31) (AASHTO also raises adjacent channel as a concern, without specificity. AASHTO at 8)

**Out of band:** Placing U-NIIs in adjacent bands used for V2V safety would have the potential to cause harmful interference.(AAM-GA at 31)

AASHTO provides an example of **co-channel interference** concerns:

Consider an example where a high-order modulation scheme like 64 QAM is used and assume the DSRC receiver requires only an SNR of 25 dB to meet the DSRC receiver performance specification. Using this SNR would infer that a broadband co-channel interfering signal would need to remain below approximately -95 dBm for 64 QAM DSRC operation to not be effected by its presence. A similar calculation for 12 Mbps DSRC operations using 16 QAM and assuming an approximate minimum SNR of 20 dB, suggests a broadband co-channel interfering signal would need to remain below approximately -100 dBm. AASHTO at 7.

Toyota list of concerns: (1) mobility of DSRC is a challenge for U-NII (2) non-persistence of DSRC devices that move quickly down the road and (3) Bandwidth mismatch between Wi-Fi and DSRC: Wi-Fi devices currently detect a transition from idle channel to busy based on a 20 MHz Clear Channel Assessment (CCA) function. DSRC signals use a similar waveform, but in a 10 MHz channel such that the “signature” is spread out compared to Wi-Fi. This signature can be detected using a modified form of the 20 MHz CCA function. CCA-based DSRC detection implies that a Wi-Fi device would need dedicated 10 MHz CCA detectors (one per DSRC channel). (Toyota at 7-9 and noting that CCA could be a basis for U-NII detection of DSRC)

Toyota also provides reasons why it thinks DFS will not work: proxy detection, range asymmetry, and CSMA transmission delay. (Toyota at 8-13) Toyota then suggests that interference models must be defined, and provides some examples of U-NII and DSRC coexistence where it says the more powerful U-NII signal, using a free space path loss model, would cause the DSRC transmissions to degrade. Degradation is important because the driver may not receive the appropriate warning signal (Toyota at 13-15) Toyota then calls out power and PSD differences between U-NII and DSRC. (Toyota at 15) Toyota says that if these concerns are not properly taken into account in interference analysis, the result will be either a signal to interference plus noise ratio leading to low packet reception by DSRC, missed packets or interference from uncontrolled channel congestion (DSRC uses congestion control). (Toyota at 15-16)

Short range of DSRC communications is a concern – several hundred meters. AASHTO at 7-8.

* 1. **DSRC - Actions the FCC or other parties should take**

Stakeholders should (1) Exchange information on respective requirements, (2) Discuss possible mitigation solutions prepared by the technical experts from the 802.11 community, and (3) Come to an agreement on a mutually acceptable solution for testing/implementation. The follow-on step may involve development and testing of prototypes in the DRSC test bed to ensure the solution works not just in the lab, but in real life, and that it is acceptable for full implementation. If brought to fruition, then industry participants would need to work closely with FCC and other government agencies to develop certification rules that unlicensed devices will use to gain FCC approval, including potentially additional tests to ensure the certification rules operate as intended. (IEEE 802 at 30) (WFA at 27) (Cisco at 65) (Cambium at 5) (ACEA at 3 – this is a global issue and all stakeholders should agree prior to a decision)

WFA supports determining the optimal technologies to protect incumbent users (WFA at 32)

Initiate process at earliest possible time. (IEEE 802 at 31) (Cisco at 65)

NTIA call for quantitative analysis is right, but requires stakeholder participation to reflect likely sharing scenarios. (Cisco at 64-65) Agrees that NTIA’s call for further study is right (GM at 3) Imperative FCC waits on results of NTIA study and finalization of a US position on compatibility before proceeding (AAM-GA at 7-8, 31-32)

Before determining whether to allow U-NII use of the 5.9 GHz band, the Commission  should  await  the  results  of  NTIA’s  study,  as  well  as  bench and field testing of any possible prototype U-NII devices designed for use in the 5.9 GHz band, the completion of work by other domestic and international organizations that are studying potential uses of uses of the 5.9 GHz band,  and  NHTSA’s  decision  later  this  year  regarding  the  future   deployment   of DSRC technologies. If, based on this activity, a concrete view is reached on whether and under what circumstances U-NII devices might be able to operate in the 5.9 GHz band without causing harmful interference to DSRC operations, the Commission should seek formal public comment on such view and any proposed rules for U-NII 5.9 GHz band operations. (AAM-GA at 8, 31-32) (NTSB at 4)

NTIA, for example, in conjunction with USDOT, is conducting a quantitative evaluation of the suitability of the 5.9 GHz band for U-NII device operations, and the implications such operations would have for DSRC.76 Its activity will involve defining the technical characteristics of DSRC systems and U-NII device deployment and technical parameters, conducting simulations under various sharing scenarios, developing initial recommendations related to the suitability of the 5.9 GHz band for U-NII operations, performing laboratory and field measurements, and ultimately finalizing recommendations to the Commission and for international study.77 As noted above, NTIA is expected to finalize its recommendations to the Commission between July 2014 and December 2014. (AAM-GA at 21) (See also Toyota at 6-7)

Qualcomm calls the NTIA plan for study “entirely reasonable” but leaves industry subject to a period of prolonged uncertainty. Offers a proposal for sharing to enable a quick decision (Qualcomm at summary iii)

Agrees FCC should conduct a thorough, data-driven analysis. ITSPAC at 1-2

FCC should “seriously weigh the subsequent, quantitative studies of the NTIA before forming any conclusions about sharing spectrum” (Utah DOT at 2) FCC should proceed with “extreme caution” (AAM-GA at 2-3) (See generally SAE at 3)

FCC should not undertake sharing studies that have a pre-determined outcome in favor of sharing. (ACEA at 3) FCC should not make an “ill-informed” decision to allow U-NII use of the 5.9 GHz band(AAM-GA at 21, referencing NTIA’s further study)

The Alliance and Global have initiated dialog with advocates of 5.9 GHz U-NII use to discuss these concerns, with the hope of achieving assurances that through bench and field testing and analysis, and additional public consultation, the interference issues discussed herein can be resolved. We stand ready to work with the Commission and other stakeholders as this proceeding evolves to address these concerns, but it is important that the Commission continue to preserve the dedicated DSRC spectrum to maximize the potential of this very promising technology. (AAM-GA at iv-v)

Sharing should not be allowed unless a set of rules can be developed and shown, through rigorous bench and field testing, to protect 5.9 GHz DSRC from harmful interference. Before any such rules are promulgated, FCC should seek further comment on them. (AAM-GA at 3, 22-23, 26, 33 noting at 26 that a follow on Further Notice will introduce additional uncertainty)

Some level of “marketplace anxiety” will continue until the FCC makes clear its commitment to adequately protect DSRC. (AAM-GA at 21-22 and referencing the TDWR cases) Unknown whether FCC sharing rules will meet DOT’s safety requirements and support existing technical standards (AAM-GA at 27 quoting DOT Dep Sec John Porcari)

AASHTO recommends “FCC take no action”. Should assemble an advisory panel of stakeholders. The FCC could then request that the potential U-NII-4 product manufacturers, in collaboration with the AASHTO State DOT members, other public sector agencies and auto manufacturers who are actively involved in Connected Vehicle proof of concept studies and who will benefit from the sale of future equipment, undertake coordinated studies to simulate, test, demonstrate, and ultimately give guidance on which candidate sharing scenarios will provide the most protection to DSRC users, while providing a viable operational profile for new U-NII-4 users. Such studies should be open and subject to critical review by the advisory panel. At the conclusion of the studies, and subsequent report on the results by the advisory panel, the FCC should have the necessary information to make an informed decision on how best to mitigate the technical challenges associated with sharing the band. (AASHTO at summary, 11-12) (See also Toyota at 6)

Savari, ITS America state FCC cannot take final action to authorize sharing now – case is unsupported and premature. Notes that Spectrum Act evidences Congress’s intent that the FCC tread carefully. (Savari at 34-35) Proposal to share faces a “high burden” . (Savari at 35) (See also Toyota at 5-6)

AASHTO wants FCC to “define sharing” – co-channel? Adjacent channel? Over same geographic area? Time-based? (AASHTO at 9-10)

NTSB wants the FCC to take into account potential delays in the development of DSRC before authorizing U-NIIs (NTSB at 4, noting that consideration of sharing has the potential to stall development) NTSB also asks that the FCC take no action until it is satisfied that the “key elements” of transportation safety systems are adequately and reliably protected. (NTSB at 4)

* 1. **DSRC - Other/history**

Due to the mentioned global character of U-NII unlicensed equipment it seems to be very likely that the usage of the bands 5350 - 5470 MHz and 5850 - 5925 MHz may be discussed in the near future also in Europe. Without prejudging any future results coming from the required compatibility and sharing studies, the Federal Network Agency would like to draw specific attention to the importance of the protection of all incumbent radio services / radio applications which are concerned in the bands 5350 - 5470 MHz and 5850 - 5925 MHz. Moreover any future designation of these bands for unlicensed (generally licensed) equipment, such as U-NII or WAS/RLANs would have to be based on enforceable measures which are derived from compatibility and sharing studies. (BNetzA at 1-2)

As NTIA report makes clear, challenges to sharing in U-NII-4 are less than in U-NII-2B, and FCC should prioritize 4 over 2B. (Cisco at 58-59)

DSRC equipment is licensed by rule. The FCC has issued licenses to state and regional transportation agencies to operate roadside units. (Cisco at 61)(TIA at 15).

NHTSA analyses states DSRC could potential address 80% of vehicle crash scenarios involving unimpaired drivers. (Cisco at 61-62.)(GM at 2 – potential to reduce 6 million crashes and 30,000 deaths) (Traffic deaths are leading cause of death for Americans aged 4 and 11-27 – AAM-GA at 9-10)

AAM-GA comment contains a detailed history of DSRC: V2V and V2I (at pages 9-12); use in traffic management (at pages 12-14); environmental benefits of traffic management (at pages 14-15; Congressional history of the program (at pages 15-16); FCC history of the spectrum allocation (at 16-17). Notes 2010 adoption of IEEE 802.11p as the standard that will be “used as the groundwork for DSRC” (at page 18) *See also* OmniAir Consortium filing for a list of ongoing test beds, demonstration projects and so forth. See also Savari Comments at 1-26 (programmatic description of the development of DSRC through present day)

(BEST TECHNICAL SUMMARY) Similarly, AASHTO provides a detailed account of DSRC and its development, with specific reference to FCC rules governing power levels, channelization, prioritization of safety traffic, standards, data rates etc. (AASHTO at 3-6)

Program has been in development for 20 years, and now approaching deployment. By end of 2013, US DOT will likely reach a decision on whether to require DSRC as a safety feature in new cars. (Cisco at 62)(TIA at 15 – DSRC in “late stages” of development) (AAM-GA at 4-5) Huge initiative so that vehicle manufacturers, vendors and other stakeholders would have an interoperable infrastructure. (AAM-GA at 19).

Work continues to evolve DSRC (AAM-GA at 19-20). Notes upcoming NHTSA action on V2V mandate, expected later in 2013. (AAM-GA at 19-20 and noting other significant research projects) Reviews US test beds and Safety Pilots. (AAM-GA at 20-21) Notes that industry has been addressing channel congestion concerns (AAM-GA at 26)

Significant resources have gone into the development of DSRC. (GM at 2) (Utah DOT at 2) (Colorado DOT at 1) (ACEA at 3 – same situation in Europe) (AAM-GA at iv)

Connected vehicles is key increasing safety on increasingly congested highways. US DOT is “commited” to the program. (AAM-GA at 9)

In Europe, auto manufacturers have worked with the FCC and European Commission on 5.9GHz “Cooperative Intelligent Transport Systems or C-ITS”. Includes V2V and V2I communications. C-ITS has been designated in a number of European countries, and a possible global allocation could be considered at the next ITU WRC. (ACEA at 1) ACEA supports a globally harmonized ITS band. (ACEA at 1)

Europe is ready for deployment beginning in 2015. Model deployments, large-scale field operational tests and demonstrations have been performed. All seven channels will be used. (ACEA at 2, 3). (AAM-GA at 5-6, noting the 2015 date is “opt in” not mandatory) Similar initiatives in Korea, Japan, China (AAM-GA at 5-6)

* 1. **Commercial licenses in the band (non-DSRC)**

Fixed satellite could be protected by establishment of protection zones and professional install requirements for outdoor installations. (WISPA at 8)

Opposes any further consideration of 5.9 GHz band for U-NII use. FCC should “abandon” the proprosals. Fixed satellite services need protection. FCC does not take into account the impact of aggregate interference to FSS receivers from U-NIIs. It proposes no realistic measures to ensure U-NII compliance and does not address the need to ensure protection of adjacent conventional C-band FSS operations. At a minimum, in-depth interference analysis is required. SES/Intelsat at 1-2. Cannot allow introduction of U-NIIs unless it is “clear” that actions will not harm existing FSS operations. (SES/Intelsat at 3, 12) If FCC wants to consider sharing with U-NIIs, it must “start from scratch.” (SES/Intelsat at 12) Legal mandate to consider additional sharing does not apply to U-NII-4. (SES/Intelsat at 12-13)

FCC characterization of band as “lightly used” is not correct. A dozen satellites use this spectrum. States that use of the band to provide services in the US is limited (due to a restrictive footnote in the Table of Allocations), the spectrum is critical for IP trunking (supporting retail broadband services), international video distribution, and international private lines. Spectrum is adjacent to “conventional” C-band FSS uplink spectrum that is heavily used for distribution of media content. This conventional spectrum is also used by Alaskan carriers to offer services in remote areas. (SES/Intelsat at 4-5)

Notice fails to consider FSS uses in proposing technical rules (SES/Intelsat at 5-6) FSS does not share common characteristics with “incumbents” in U-NII-3. FSS satellites are in geostationary orbit and can see a footprint that covers millions of miles – this creates issues with aggregate interference from U-NIIs. Cites recent cases noting the need to protect FSS from harmful interference. Commission’s analysis is flawed. (SES/Intelsat at 5-9)

Notice also fails to consider adjacent channel interference into conventional C-band networks. Claims that record shows some TDWR interference was adjacent channel. Cites unauthorized device modification as a concern. Effectiveness and enforceability of FCC rules are unproven. (SES/Intelsat at 9-10)

Device compliance is a large concern, raising TDWR case. Once in the marketplace, devices cannot be retrieved. Geolocational database is not a solution to protect FSS. Neither could DFS or spectrum sensing. (SES/Intelsat at 11-12)

Amateur is a secondary allocation at 5650-5925 MHz. From 5650-5670 MHz is a amateur satellite uplink and the downlink is 5830-5850 MHz. There is an “overall” allocation to Amateur at 5850-5925 MHz. (ARRL at 1) Notes that the FCC asked Amateur to work around U-NII to the extent possible, as Amateur had more spectrum. (ARRL at 2) With the DSRC allocation in 1999, and the expanded U-NII operation in 2003, put additional pressure on spectrum, which has been managed to date by relatively low density of U-NIIs. In its January report, NTIA raises the same concerns that ARRL has been raising with the FCC as the 5 GHz allocations changed – aggregate interference. FCC should not allow U-NIIs to operate without benefit of NTIA studies, which should also take into account amateur operations. (ARRL at 1-10) ARRL notes that its experience in sharing in U-NII-2C is “reasonably positive” (AARL at 13)

Amateur uses above 5830 MHz, the Amateur Satellite Service downlink band is at 5830-5850 MHz and the segment 5830-5925 MHz is used for analog and digital wide-bandwidth (i.e. those using emissions of greater than or equal to 1.0 MHz occupied bandwidth) applications. These include high-speed data (e.g. 802.11 protocols), Amateur television and other high- bandwidth, high-speed multimedia Amateur Radio applications. Channelization of that segment is based on regional needs and usage. States that co-existance with DSRC is do-able, but not with “mobile” U-NIIs. (ARRL at 11-12)

* 1. **Federal systems in the band**

Notes the Spectrum Act did not provide a specific test for protection of U-NII-4 incumbents, but states that the more general public interest test “will be its lodestone in evaluating the opening “ of U-NII-4. TIA at 14.

Going-in hypothesis should be that DFS could work to ensure that radar systems do not suffer interference. NTIA is in the best position to evaluate. (IEEE 802 at 29) (Cisco at 59) (See generally CEA at 15-16) (WISPA at 8) Needs to be further evaluation of whether existing DFS addresses U-NII-4 radar operations, or if DFS will need to be modified. (WFA at 28) FCC and NTIA should identify any changes to the radar detection and DFS rules that might be necessary. (Cisco at 59)

Ericsson will “accept” DFS requirements if deemed absolutely necessary to protect incumbents, can be cost effectively implemented, and utilize defined parameters – issue is false detection. (Ericsson at 3, 10) Do not retroactively apply any new DFS to current bands (Ericsson at 10-11, noting the false positive issue, which interfere with device functionality) (*See also* NCTA at 21-22, asking that DFS not apply outside of U-NII-2) Time Warner Cable does not think a DFS requirement is necessary. (Time Warner Cable at 13.)(See also Cablevision at 7 – no DFS outside of U-NII-2)

In response to the questions about sub-microsecond pulsewidth detection capability, note that ETSI is requiring detection of 0.5 microsecond pulsewidths – which represents industry’s present capability. Issues not detection of a single pulsewidth – but detection of the radar bursts over a test pattern to a measured probability of detection. (IEEE 802 at 29) (WFA at 28-29)(Cisco at 59-60) (Ericsson at 10)

Sharing with radar in low-power modes or radar not subject to detection does not appear to be a problem. DSRC has long been slated for operation in this band, and no detection requirements are imposed on DSRC technology. Not clear why U-NII operations would impose an increased risk. Cisco at 60.

Imposing **adjacent channel sensing** **is not necessary**. No real world examples to support that this is a problem. (IEEE 802 at 29) Opposes adjacent channel sensing requirement. Will degrade operation of commercial U-NII equipment and no showing that it benefits incumbents (WFA at 28) **No basis to impose geolocational databases** in the band. (Cisco at 60) (Ericsson at 3 – study it further, but don’t delay decisions to open spectrum using other mitigation techniques) (*But see* AAMI at 6, stating that a TV white spaces database could be used in the band, or possibly “other mechanisms)(See also GOOG/MSFT at 10, noting geolocational database would be appropriate for federal fixed transmitter locations)

WFA supports determining the optimal technologies to protect incumbent users (WFA at 32)

Supports outdoor use by U-NII with harmonized emissions rules. (GOOG/MSFT at 5-6)

* 1. **Emissions rules for U-NII-4**

FCC proposes to apply 15.407 to this band, but the technical parameters for operation in U-NII-4 represent part of the sharing solution that must be developed. (IEEE 802 at 31) (*See also* GOOG/MSFT at 5-6, generally favoring outdoor uses across 5 GHz with harmonized emissions rules) Ericsson prefers rules that align with U-NII-3 and allow wireless backhaul, point-to-point, point-to-multipoint and mesh, and non-line-of-sight. (Ericsson at 9) (See also CEA at 3,11, 12-13 – harmonize where feasible, helps manufacturers scale and lowers equipment cost, speeds certification & therefore speeds innovation to market, supports 802.11ac) WISPA – OK with 15.407 for this band, but wants option of 15.247 for U-NII-3. (WISPA at 7-8.)

Pending completion of sharing evaluation and testing, WFA tentatively agrees that the U-NII-3 rules should apply across the 200 MHz of spectrum that will comprise the U-NII-3 and U-NII-4 bands. (WFA at 27) (TIA at 3 – generally supporting harmonization to the maximum extent possible consistent with providing appropriate protection to incumbents) (Ericsson at 10, but noting further study is needed to determine if U-NII operations will harm DSRC) (NCTA at 2, 12-13 and no DFS)

Aligning U-NII-4 rules with U-NII-3 & allowing outdoor use helps cable operators by providing a contiguous 160 MHz channel. (NCTA at 18)(Time Warner at 3, 11 – noting ability to combine noncontiguous 80 MHz channels with U-NII-3 or U-NII-1) (Cablevision at 6)Higher power means greater coverage, throughput, etc. FCC should strive to set the power limits at the “highest feasible level.” (Time Warner Cable at 12) Time Warner Cable wants rules to support point to point links of the type used in its mesh networks (Time Warner Cable at 13) (See also Cablevision at 5-6)

As a starting point, concur with FCC view that same general framework of U-NII-3 should apply to U-NII-4, except as necessary to co-exist with DSRC. (Cisco at 64, stating that a “substantial amount of technical exchange” will be needed to determine the efficacy of rules)

*But see:* AAM-GA Comments on Power Limit Disparities and Sensing Concerns: co-channel. DSRC has much lower power than radars. V2V operates at 18-20 dBm EIRP. Notice proposed much higher power levels for U-NIIs. (AAM-GA at 29 (co-channel) & 31(adjacent channel))

AASHTO disagrees that U-NII-3 rules should be applied. Need different rules. (AASHTO at 11, implying power levels too high) Presents analysis indicating the U-NII-4 user will need to be 8 miles from the DSRC receive to avoid the possibility of causing interference. (AASHTO at 13) Presents a second example where under U-NII-3 rules, and elevation of U-NII device to 36 meters, extent of interference is large. (AASHTO at 13-16) Recognizes there are more assessments and mitigation concepts that may be proposed & AASHTO wants to be active in consideration of these. (AASHTO at 16-17)

AASHTO rejects DFS which it calls “frequency hopping” as a means to protect DSRC. “Severe technical complexities” exist due to disparity in power levels between U-NIIs and DSRC (using U-NII-3 rules) (AASHTO at 17)

With no sharing proposal, impossible to provide comment on emissions rules, since the sharing mechanism could influence those rules and commenters don’t have a means to analyze the potential for band sharing. (Savari at 34-35)

If FCC authorizes U-NIIs to sue the band, AARL suggests as a starting point the 2003 WRC requirements: 250mW, plus TPC and “mitigation measures” including DFS. (ARRL at 12) Not clear that these will protect amateur. ARRL at 12-13 – but notes it could get some protection).

1. **U-NII-2B**

Generally supports opening the band. Act in a technologically neutral manner and afford suitable protections for incumbents. (TIA at 3 – generally supporting harmonization to the maximum extent possible consistent with providing appropriate protection to incumbents) (WISPA at 6 – supports opening the band and prefers outdoor uses)

* 1. **Agreement on federal services as primary – no interference**

Agrees. (IEEE 802 at 31) (WFA at 29) (Cisco at 66 – reciting legal standard from the Spectrum Act) (CEA at 14-15 and supporting an FCC examination of whether the band can be opened for unlicensed use))

Spectrum Act makes clear that sharing of 5350–5470 MHz can only be authorized if the Commission, in consultation with NTIA, concludes that there are technical solutions available that assure that protection to licensed users and that federal spectrum users in the band are not compromised by the introduction of U-NII devices. NTIA has conducted evaluation of this band as required by the Act, and concluded that further analysis is required. Clear that the process won’t be easy because the number of sharing scenarios are greater. (TIA at 13)

* 1. **Other licensed systems**

NAB is concerned that opening U-NII-2B will have an adverse effect on broadcasters’ weather radars. These systems must be fully protected from interference. (NAB at 1-2) (Baron at 1-2 “absent adequate operating prohibitions and technical and service rules” but also “strongly urges the Commission to prohibit U-NIIs in the band”) (ADC at 2-3 – “deeply concerned” because its radar are more sensitive than TDWR by 11 dB)

Based on published sources, we estimate the minimum detectable signal (MDS) for TDWR to be -114dBm . The corresponding value for DOPRAD is -125 dBm. The minimum signal that causes disabling interference is not necessarily the same as the MDS, but is likely to differ between the two technologies by a similar amount. (ADC at 3 and footnote 7)

U-NII devices have a “history of causing harmful interference” – adjacent and co-channel. (NAB at 2) (Baron at 2) Wants improvements to rules to ensure that all U-NII devices in the 5 GHz band can protect radars. (NAB at 2, 4) (*Contra* – Ericsson comment) Wants geolocational database solution and enhanced security requirements. (NAB at 4) Wants sensing over 100% of bandwidth (NAB at 5)

Recites Congressional statute – licensed users will be protected. Notes NTIA is conducting further studies, and encourages FCC to await those studies. (NAB at 3) (Baron at 2, 3, 17-18 – must have “proof” interference will not occur) (Hubbard at 1 “clear risk of unmitigated harm” if U-NIIs allowed to share; at a minimum must await NTIA studies)

If FCC nonetheless allows U-NII operation, FCC must adopt “every reasonable interference protection mechanism” to protect weather radars. (Baron at 2).

Co channel protection is not enough. “Demonstrated” adjacent channel interference to TDWR require adjacent channel protections. Baron at 3. Quotes the FCC’s NPRM as source for view that adjacent channel exists. (Baron at 4) Quotes NTIA report as source for statement that properly functioning DFS devices failed to protect TDWR. (Baron at 4) Can be no doubt from NTIA report that U-NIIs have seriously potential to degrade incumbents’ operations. (Baron at 4-5) (See also Hubbard at 2-4)

Quotes NTIA 2006 report that TDWR are susceptible to interference from U-NIIs because the radar cannot process the signals and mitigate, and therefore the radar will lose information about the target weather system. (Baron at 7) Quotes NTIA that the loss of data is “insidious” and that the operator is not aware that the loss is occurring” Only way to prevent this is not to allow U-NII operation. (Baron at 7-9) (See also Hubbard at 4-6)

* 1. **Specific proposals for sharing**

Sharing issues here are new and novel. Benefits to contiguous spectrum are so large that evaluation must be undertaken (IEEE 802 at 31) (WFA at 29) (Cisco at 65-66) Agrees with NTIA’s characterization of mitigation techniques known today. (WFA at 29)(Cisco at 67)

Starting point – make modifications to DFS. Agrees that airborne and spaceborne SAR operations will present sharing scenarios not considered when U-NII rules were adopted. (Cisco at 67) Agrees with NTIA’s call for further analysis (Cisco at 67)(See generally CEA at 15-16)(See generally Fastback at 11) (See also WISPA at 7)

Ericsson can “accept” DFS requirements if deemed absolutely necessary to protect incumbents, can be cost effectively implemented, and utilize defined parameters – issue is false detection. (Ericsson at 3,10) Modify DFS for 2B as necessary but do not expand DFS to additional bands because of high cost and significant operational considerations (NCTA at 2, 13) No new sharing requirements for 2B (Motorola Mobility at 8-9)

Not clear that geolocational databases are the answer – many questions about how such a solution would work when the government transmitters are not fixed, or are protected as a national security matter. These are very different from TV white spaces database design issues. (Cisco at 68-69). (Ericsson at 3 – study it further, but don’t delay decisions to open spectrum using other mitigation techniques) But AAMI supports use of a geolocational database or “other mechanism” proposed by the FCC. (AAMI at 6) So does GOOG/MSFT. GOOG/MSFT promote geolocational databases as a good mitigation technique that may be less difficult and burdensome than DFS. For EESS and similar services, a database could protect the satellite operations when satellites are overhead or on a geographic basis as necessary. (GOOG/MSFT at 7) (See also Baron at 11-12)

Cambium expresses concern about a variety of sharing mechanisms. Signal sensing might be difficult or expensive if the two radio systems have different air interfaces. Cooperative sensing might give rise to security challenges. Geolocation solutions may not work if the incumbent is mobile or nomadic, if the incumbent cannot reveal its location for security reasons or the U-NII cannot access the public Internet. Additional protections might be needed for directional antennas. Beacons require additional receivers. Notes the discussion of beaconing in the NPRM does not align with IEEE 802.22’s version, which protects a specific transmitter, telling other devices not to transmit, but says it is not clear how it would work when applied to a distributed network. (Cambium at 5-6)

ESA is “willing to cooperate” with FCC in studying the sharing environment and studies are underway. (ESA at 2)

Baron suggests adoption of modified DFS rules: (1) Wants sensing at 100% of occupied bandwidth, not 80% as today, to address co-channel interference (2) 30 MHz frequency separation from radars for U-NIIs with 20 MHz channelization and greater separation if U-NII employs wider channels (3) geolocational database (citing NTIA’s reports that show DFS devices not detecting radar on adjacent channel) (4) geolocational capability ( professional install insufficient) (Baron at 10-14). Whatever the FCC decides to do to protect TDWR should apply here to broadcast weather radar. (Baron at 14-15)

Baron also wants: (1) FCC to use more restrictive interference thresholds to protect radars (2) improved security to prevent user modification (3) require U-NIIs to transmit information on their location and identity and(4) mechanisms that prevent users from disabling DFS. (Baron at 15-17)

Notwithstanding DOPRAD’s greater sensitivity to interference, ADC seeks only the same separation distances the Commission has proposed for TDWR. We note, however, that the Commission’s examples for the TDWR band and proposed for the DOPRAD band is 13 dB higher: 24 dBm (250 mW) into a 6 dBi antenna, for an EIRP of 30 dBm. The proposed separation distances for both TDWR and DOPRAD will thus have to be adjusted upward for unlicensed devices operating at or near maximum power and/or antenna gain. ADC at 3-4.

* 1. **Actions FCC or other parties should take**

Must work with NTIA to progress the issues here. (IEEE 802 at 31) (WFA at 29)(Cisco at 69)

WFA supports determining the optimal technologies to protect incumbent users (WFA at 32)

FCC should take steps to promote and lead meetings, panels, workshops and other discussions among stakeholders to expedite a data-driven decision process. (TIA at 14)

* 1. **Other/history**

5350-5470 MHz not allocated to the mobile service today. (ESA at 1)

About 150 weather radars in the band operated by broadcasters. (Baron at 1-2) These radars perform a crucial public safety function, warning of dangerous weather. (Baron at 6) Hubbard at 7-10 (noting utility of continuously updating weather radar in showing the path of tornadoes)

ADC distributes DOPRAD radars, based on the Rockwell Collins WRT- 701C, that operate in the 5.35-5.46 GHz band. (ADC at 1) Used by 40 broadcasters for weather forecasting and public safety alerts, NASA (for logistics support), U.S. Customs and the U.S. Air Force in Tethered Aerostat Radar System sites along the southern border, and by the U.S. Air Force overseas. Figures 1 and 2 show typical equipment. (ADC at 2)

History of sharing with EESS: Sharing between RLAN and EESS(active) led to Recommendation ITU-R RS.1632. This Recommendation contains the technical and operational conditions for sharing between RLAN systems and EESS(active) systems. At WRC-03, the conditions indicated in ITU-R RS.1632 were introduced in WRC-03 Resolution 229, but with the addition of text allowing individual administrations to introduce unspecified alternative methods to achieve the protection of the EESS(active) systems. This addition was due to the fact that an administration had already introduced national regulations for the operation of RLAN systems in this band and these regulations were not compatible with the constraints contained in Recommendation RS.1632. These alternative methods remain unspecified today. This has created large uncertainty about the protection levels “enjoyed” by the EESS (active) in the 5250-5350 MHz band. As a result, when GMES was being built, Europe chose 5350-5470 MHz because there were no RLANs present. (ESA at 1-2)

New satellites equipped with EESS(active) sensors operating in this band are about to be launched, starting from the second half of this year. These new satellites will constitute the basis of a large programme of Earth observation from space, created in cooperation between the European Commission and ESA. The programme is called GMES (Global Monitoring for Environment and Security aka “Copernicus”). This programme represents a major investment by Europe in the field of environment monitoring and security. Guarantee of protection from RF interference for the satellite measurements is essential to the success of the initiative. (ESA at 1)

* 1. **Emissions rules for U-NII-2B**

Agrees that emissions rules from 15.407 should be applied.(IEEE at 31-32)(WFA at 30) (Motorola Mobility at 8) (Ericsson at 9-10 - align with U-NII-2 rules providing access to user devices and provide access to entire 475 MHz of band) (See generally CEA at 3, 11, 12-13 – harmonize where feasible, helps manufacturers scale and lowers equipment costs, speeds certification & therefore speeds innovation to market, supports 802.11ac)(Fastback at 10 – adopt “expeditiously”) (WISPA at 6-7 – agrees 250 mW is sufficient)

Opposes new out of channel emissions limits. (IEEE 802 at 32)(WFA at 30)(Fastback at 10-11, noting the -41 dBm/MHz limit as a problem)There is no similar rule for U-NII-2A or U-NII-2C and there is no suggestion that the likelihood of interference from outdoor devices in the 2B band is any greater than in 2A or 2C. (WFA at 30)

Within the U-NII-2B GHz band, the minimum 6 dB bandwidth of U-NII devices should be at least 500 kilohertz. (WFA at 30)

Favors outdoor uses of the band with harmonized emissions rules to the maximum extent possible (GOOG/MSFT at 5-6)

1. **Other issues raised**
	1. **NTIA Report – reviews and reactions**

WFA appreciates the NTIA Report and the progress in analyzing the bands. WFA does not support application of database technologies are necessary to support sharing. (WFA at 32-33)

WFA notes NTIA models must be extended to femtocells and vehicles to include new applications and deployment models (WFA at 33)

Too early to tell if NTIA correctly catalogued the risks to federal systems (WFA at 33)

WFA disagrees with the assertion that DFS does not work – no evidence to demonstrate this. (WFA at 33)

Timetable is too long. FCC and NTIA should accelerate the process. The 2.4 GHz band is nearing exhaust and the 802.11ac standard will be published next year. Manufacturers need time to implement new rules. If the Commission delays per the NTIA report, the US will not have a single 160 MHz wide channel useful for outdoor operations – a result that is “clearly unacceptable.” (NCTA at 25)

Ericsson’s observations – if concerns about the reliability of sensing-based technologies can be addressed, then Ericsson is generally in favor of DFS/sensing technologies; as an alternative, Ericsson would consider geolocation-based technologies, including a database; and after further study, Ericsson would also consider use of a beaconing/pilot channel (Ericsson at 11-12)

* 1. **WRC-15 prep**

Notes NTIA set forth milestones throughout 2013 and 2014 for coordinating international studies needed in preparation for the WRC-15. NTIA states it is doing so to “best position the United States for work in the ITU-R as other countries will inevitably bring forward studies on these bands”. FCC can support by moving this proceeding expeditiously, developing domestic approaches to sharing that can be shared at the WRC-15. (TIA at 7) (NCTA at 13 – FCC should use WRC-15 to promote robust unlicensed operations in 5 GHz)

Ericsson posits that the ideal manner for the Commission to further the U.S. position at WRC-15 is to move this proceeding forward expeditiously; developing domestic approaches to sharing that can be shared at WRC-15 in furtherance of America’s global leadership with respect to the 5 GHz band. (Ericsson at 3)

Notes US has submitted a proposal to extend RLAN usage to the band 5350-5470 MHz by adding a mobile allocation. Studies evaluating the compatibility with existing services have started and will be completed on time for WRC-15. (ESA at 2)

No national regulation should be approved before the ITU-R compatibility studies are completed and a decision is taken at WRC-15. This would be the only way to avoid a repetition of the WRC-03 situation where the technical studies results had to be modified to accommodate existing national regulation. (ESA at 2)

ACEA notes that industry may propose a globally harmonized band for ITS at WRC-15. States that the time schedule for this is “ very tight” and a sharing solution needs testing and validation. (ACEA at 2,3) (*See also* AAM-GA at 8, noting the need to await results of international organizations before making a determination)

The  United  States  is  further  investigating   compatibility between U-NII devices and DSRC operations as it develops its position on possible uses of the 5.9 GHz band internationally  for  the  ITU’s  WRC-15 and other fora. This international work is being performed under the State Department’s International Telecommunication  Advisory  Committee  (“ITAC”), which is studying U-NII and incumbent system  characteristics  to  address  the  risks  identified  by  NTIA’s  5  GHz  Report  and  determine   whether and under what conditions spectrum sharing might be possible. These studies must be  finalized  by  the  end  of  2014,  coinciding  with  the  finalization of  NTIA’s  study,  in  preparation   for WRC-15. Additionally, other nations are likely to proffer their own studies on uses of the 5.9 GHz band before and at WRC-15.1 (AAM-GA at 32)

* 1. **Healthcare spectrum prioritization**

Compares demand for wireless connectivity in healthcare to the needs of military – ‘rapidly increasing demand’. (AAMI at iii) Some applications affect patient and/or pubic safety and require controlled RF environments where spectrum utilization can be managed to reduce harmful interference. (AAMI at iii) *[General demand for healthcare uses is summarized with “demand drivers” at the top of this comment summary]*

Agrees that there is a “pressing need” to allocate additional unlicensed spectrum, and states there is also a concern to support access to spectrum for “critical interference-sensitive applications for healthcare.” Allieviating congestion and interference from unmanaged sources is key. (AAMI at 4 – also noting heavy use of commercial off the shelf unlicensed technology in healthcare) Congestion challenges the ability of healthcare provider to ensure safe and effective operations and risk management. (AAMI at 4-5) Seeks an allocation of ‘controlled interference” – an environment which provides a higher level of deterministic access, controlled utilization and managed co-existence. (AAMI at 4-5)

The 14 MHz of spectrum allocated for Wireless Medical Telemetry Service is experiencing “increasing use” (AAMI at 5) But this spectrum, in 600 MHz band, is uncertain due to the Congressional requirement for incentive auctions. (AAMI at 7) Recent allocation of 40 MHz for Medical Body Area Sensor Networks appropriately limit its use to low power wideband body-worn sensor and hub devices – but also represent a possible interference management approach. (AAMI at 5)

Spectrum in the 3.5 GHz and as a solution does not appear to be useful because medical applications by themselves have the volumes to generate equipment scale and scope, standards are not in place and this resolution could take “many years”. (AAMI at 7-8, also noting that 4.9 GHz is not an option due to lack of equipment, limited bandwidth and uses by public safety)

Medical equipment vendors are increasingly turning to 2.4 and 5 GHz. This is challenging because devices brought onsite by visitors and staff can create interference. There is no ability to reserve bandwidth for critical applications and the exploding use of Wi-Fi make spectrum management challenges hard. (AAMI at 8-9)

Ultra-high bandwidth technologies such as IEEE 802.11ac require complex legacy compatibilities that may be perceived by hospitals as “inconvenienced” by medical devices despite their clinical nature. Future uses of the proposed U-NII band are very hard to predict at this point, but they point to an increasing mobility and a reduced ability for institutions to manage the spectrum use in their own facilities. (AAMI at 9)

AAMI proposes a “secondary measure” to offer a higher level of risk management and mitigation in healthcare: adopt a mechanism that would provide to healthcare delivery organizations a healthcare vicinity-based prioritized access to a subset of the proposed 5 GHz band for deployment of critical, interference sensitive healthcare applications. Policy reasons – patient safety and life critical. (AAMI at iii-iv, 5-6, 9-10) Spectrum could be designated in either 2C or 4. (AAMI at 5)

“Controlled interference” spectrum would allow the re-use of commercial solutions that lower cost of development and implementation of life-saving applications, allow access to state-of-the-art technology and higher data rates, and provide enough bandwidth for ultra-high bandwidth devices using .11ac (AAMI at 10)

Prioritized access to spectrum in the vicinity of registered critical users is much needed and practical. (AAMI at 10) FCC should implement a mechanism (e.g., TV white spaces database or other geo-location technology, sensing or beaconing/pilot channel) to allow heathcare institutions to gain priority access, prohibit non-priority use, and permit coordination with other prioritized users. (AAMI at 10-11) Proposal would only restrict access in highly specific geographic areas, affecting less than .05% of the US population. (AAMI at 11)

The same locally prioritized access could also be made available to other industrial users that need to use the spectrum in a “controlled interference” environment. Suggest that this could be managed via a geolocational database similar to TV white spaces. (AAMI at 5-6)

* 1. **Introduce a technology neutral etiquette to promote efficient utilization of the band**

For all devices operating in the U-NII bands, Ericsson urges the Commission to consider introducing technology neutral mechanisms to promote harmonious operation in the bands, possibly including etiquettes or other techniques that enable use of the band in a spectrally efficient fashion to try to prevent the “tragedy of the commons” that has occurred at 2.4 GHz. (Ericsson at 3)

* 1. **No tech mandates**
1. Don’t mandate technologies or uses. Keep use of the band flexible to allow markets to drive equipment and uses of the equipment. (CEA at 10-11; TIA at \_\_)
	1. **Sub 1 GHz**

In order to provide some further simplification of the rules, IEEE 802 proposes that the Commission change the PSD requirements from 8 dBm/3 kHz to 23.2 dBm/100 kHz for the sub-1GHz unlicensed bands to harmonize the PSD measurements with Part 15 Subpart H rules. (IEEE 802 at 25) (WFA at 31)

**References:**